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An analysis of expanding the defense industrial base through civil-military integration

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THESIS

AN ANALYSIS OF EXPANDING THE DEFENSE INDUSTRIAL BASE THROUGH CIVIL-MILITARY INTEGRATION

by

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June 1998

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Current initiatives to promote civil-military integration such as dual-use science and technology, the commercial operations and support initiative and commercial technological insertion project are described. An evaluation of the costs and benefits of civil-military integration is provided.

This thesis also reviews the barriers to implementing civil-military integration. The researcher's analysis concludes that the existing regulatory barriers to civil-military integration prevent it from becoming a viable policy option for expanding the defense industrial base.

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AN ANALYSIS OF EXPANDING THE DEFENSE INDUSTRIAL BASE THROUGH CIVIL-MILITARY INTEGRATION

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I. INTRODUCTION

A. GENERAL

The defense budget of the United States has been reduced significantly since the end of the cold war. Additionally, the procurement and investment accounts have been cut by a greater percentage than the overall defense budget. To remain profitable many defense firms have merged or acquired other defense firms, closed underutilized facilities and reduced the defense-related workforce. The consolidation of the defense industry has raised concerns about the level of competition within the industry, the ability to compete against foreign firms, and dependence on foreign manufacturers.

Government policy preventing consolidation of the defense industry may have resulted in weaker, smaller, and less efficient firms trying to compete against foreign suppliers. Further, an autarkic defense industrial base may be too expensive to maintain and may be unable to respond to the Government's need the way an integrated competitive global market could.

In a prepared statement to the Senate Armed Services Committee, the Under Secretary of Defense for Acquisition and Technology USD (A&T) stated "We must restructure the defense industrial base in order to achieve civil-military integration: to broaden the industrial base (for greater efficiency and competitiveness) and to take full advantage of the commercial information technology revolution." [Ref. 1]

Civil-military integration is offered as a solution to providing a larger, stronger, and more-competitive defense industrial base. However, many existing policies and regulations interfere with civil-military integration by discouraging firms from

contracting with the Department of Defense (DoD). An understanding of the differences between the traditional defense market and the free market, and the barriers that separate them, is needed before integration can be accomplished.

B. OBJECTIVES

The primary objective of this thesis is to determine what role the Government should have in the integration or expansion of the defense industrial base. Should it be a paternalistic regulator or a promoter of a free market?

Other objectives are to determine the desirable characteristics of the defense industrial base and to find if the benefits of civil-military integration outweigh the costs.

C. SCOPE

This thesis identifies the differences between the weapons acquisition market and the traditional free market in which commercial firms operate. Policies aimed at promoting civil-military integration to expand the industrial base will be discussed as well as the barriers that discourage integration. Due to the importance of the defense industrial base to national security, the policies discussed were not based solely on economic criteria. This thesis will make an assessment of whether the industrial base should be expanded by reducing barriers and encouraging free-market actions or by regulating and managing the structure of the base.

The information provided in this thesis will furnish procurement officials with an understanding of the dynamics of the supply side of the defense market.

D. RESEARCH QUESTIONS

To achieve the objectives of this study, the primary research question was:

Is civil-military integration a viable policy option for expanding the industrial base?

From the basic research question, the following subsidiary questions were developed:

1. How does the weapons market differ from the free market?
2. What are the benefits of a strong defense industrial base?
3. What are the benefits and costs of civil-military integration?
4. What are the barriers to civil-military integration?
5. At what stage of the acquisition cycle should efforts be directed at expanding the industrial base though civil-military integration?

E. ASSUMPTIONS AND LIMITATIONS

Three primary assumptions relevant to this study have been made. First, the reader understands basic economic theory. Second, the literature reviewed for this study is complete and accurate as of the date of this study. Finally, defense contractors respond to incentives and disincentives similar to other commercial firms when free of Government interference.

Several ideas and thoughts presented in the first part of this thesis are shared by multiple sources; however they will be referenced to only one source.

F. METHODOLOGY

The data for this study were obtained from several sources. First the researcher conducted an extensive review of available literature. This literature review consisted of a local library search, intra-library loans, a custom search on LEXIS/NEXIS, and use of the Internet.

Secondly, several telephone interviews were conducted with various individuals involved in DoD acquisition policy.

G. THESIS ORGANIZATION

This thesis consists of seven chapters. This chapter provides the objectives, scope, and methodology for data collection. Chapter II addresses the budget reductions and consolidation of the defense industry. A comparison of the weapons market to the free market is presented. Chapter III discusses civil-military integration as a means of expanding the defense industrial base. Chapter IV discusses the benefits and costs of civil-military integration. Chapter V addresses policies that may prevent expansion of the defense industrial base through civil-military integration. Using the information collected, Chapter VI provides an analysis of the information collected. Chapter VII provides conclusions and recommendations for the best policy options regard expansion of the defense industrial base through civil-military integration.

II. THE DEFENSE INDUSTRIAL BASE

A. DEFINITION OF DEFENSE INDUSTRIAL BASE

The defense industrial base (DIB) is defined as "the combination of people, institutions, technology, and production capacity used to develop and manufacture the weapons and supporting defense equipment needed to achieve our national security objectives." [Ref. 2:p. 5] DIB is a subset of the larger national industrial base.

The DIB is also multi-dimensional. It comprises contractors, subcontractors and parts suppliers, and it consists of companies that provide facilities supporting air, land and sea systems. [Ref. 3:p. 184] These facilities may be privately owned and operated, or Government-owned and contractor-operated, or Government-owned and Government-operated. Many of the firms operate in multiple sectors of the base, either supplying more than one system or serving as both a prime and subcontractor on different contracts.

The DIB should not be treated as a "single, homogeneous entity." The multi-dimensional aspect of the DIB and the varying degrees of dependence on defense sales make the development of any broad DIB policy difficult.

The three components of the DIB are: technology, production, and maintenance.

- The technology component includes private industry, university, and government laboratories, research facilities, and test centers that conduct research.

- The production component consists of private and public manufacturing facilities, including Government-owned and Government-operated, Government-owned and contractor-operated, and contractor-owned and contractor-operated facilities.

- The maintenance component consists of private and Government facilities (such as arsenals and depots) that maintain and repair equipment. [Ref. 2:p. 5]

B. IMPORTANCE OF THE DEFENSE INDUSTRIAL BASE

A strong defense industrial base enables the United States Government to respond to contingencies such as those in Bosnia, and to deter threats from other nations. Decisive victories such as Desert Shield and Desert Storm demonstrated that well-equipped and technologically superior forces are needed to deter aggression. As changes have occurred in the world's geographic, political, and economic structure, the Federal budget and defense forces have adjusted force structure to meet current threats.

The break-up of the former Soviet Union resulted in a change of military strategy and plans for the industrial base. The previous cold-war assumption that global warfighting required expansive inventories of weapon systems, repair parts and consumables has been replaced by the assumption of regional conflicts with smaller but technically superior forces and just-in-time logistic support. According to the Swedish International Peace Research Institute, thirty armed conflicts were fought throughout the world in 1996. "Each conflict involved an ethnic faction, religious extremist group, or terrorist organization; none pitted one recognized nation against another." [Ref. 4:p. A10] Although some of these groups may have been state-supported, this change in strategy resulted in significant reductions in defense spending.

C. BENEFITS OF A DEFENSE INDUSTRIAL BASE

There are several benefits to maintaining a defense industrial base: self-sufficiency, less reliance on foreign supply, leverage, economic benefits, and security.

1. Self-Sufficiency and Capabilities

A benefit of self-sufficiency is that a nation will not have to rely on foreign sources that may become unreliable during a conflict. A domestic defense industrial base enables the Government to maintain a capability that it believes it will need in the future, and enables the Government to avoid the cost and time required to recreate it. This was a primary argument for not canceling the Seawolf submarine. Depending on the number of foreign suppliers, foreign supply could also leave the buyer vulnerable to a monopoly price increase. A domestic DIB should prevent a nation from becoming locked in to the use of a foreign supplier who could then charge monopoly prices for spares and support. Conversely the nation could become dependent on an inefficient domestic producer in order to support self-sufficiency.

2. Less Reliance on Foreign Supply

Foreign supply may provide equipment not tailored to a nation's requirements. A nation without a defense industrial base may have to rely on weapons designed and manufactured for the originating country's needs rather than tailored to the threat facing the purchaser. During time of conflict, support from a foreign supplier could also disappear due to internal and/or external political pressures.

Countries such as the U.S. are still dependent on foreign materials and suppliers. An assessment conducted on three U.S. Navy weapon systems found that the number of foreign suppliers increased at the lower tiers of the contractor base from one percent of second tier suppliers to 12 percent of fourth tier suppliers. The prime contractor is considered the first tier, his subcontractors the second tier, and the subcontractor's immediate suppliers the third, etc. Foreign sources ranged from five percent at the

second tier for the HARM missile and Mark-48 torpedo to forty percent for the Verdin communications system. The largest foreign supplier to the U.S. was Canada (42% of foreign procurements) followed by Japan (19 percent), the United Kingdom (seven percent), Germany (five percent), and South Africa (four percent). [Ref. 5:p. iii]

The Commerce Department also found that in the case of the weapon systems studied, most foreign dependencies for the U.S. were for raw materials in which the United States has no economically-viable concentration such as nickel, tantulum, and chromite.

3. Leverage

A country with a strong DIB can use that leverage when negotiating with foreign firms. Yet this importance should not be overstated. A country with a small DIB may just as easily threaten to go to a rival supplier on the world market. A country looking for tanks could threaten to buy M1A1 tanks from the U.S. supplier, General Dynamics, or Challenger tanks made in the UK by Vickers. Countries without the capabilities to develop and manufacture fighter aircraft may also shop the world market and negotiate for lower prices or performance upgrades and further request offsets to help their balance of trade.

4. Economic Benefits

According to Sandler, a defense industrial base provides national economic benefits. [Ref 3:p. 185] The benefits take the form of jobs created, technological advances, and exports. This is a Keynesian outlook and ignores the fact that those same resources could possibly be used more efficiently in the private sector. When looking at the nation as a whole, there is no evidence that money spent on defense creates more

jobs or benefits the economy greater than money spent in the private sector. Even at the local level there is evidence that private industry can provide benefits to the local economy more efficiently than the Government.

When speaking strictly of jobs attributed to procurement funding, there are still 400,000 more defense contractor employees working in the U.S. industry today than were working at the low point of the Cold War defense budget in 1976. [Ref. 6:p. 14] However, according to the Aerospace Industry Association, aerospace employment nationwide has declined 41 percent since 1989. [Ref. 7:p. 212] It is possible that the aerospace workers changed careers and took employment in private industry or are now employed in a field not categorized as aerospace.

5. Security

In an article titled "The Defense Technology and Industrial Base: Key Component of National Power," Boezer argued that there is a close relationship between national power and the nation's manufacturing capability. A vote on maintaining production potential can have a profound affect on perceived power. "As the period between crises increases, the industrial base grows cold from neglect and the risk to national security increases correspondingly." [Ref. 8:p. 27] The National Security Act of 1947 requires the National Security Council to:

> ...assess and appraise the objectives, commitments, and risks of the United States in relation to our actual and potential military power, in the interest of national security, for the purpose of making recommendations to the President in connection therewith. [Ref. 8:p. 27]

A strong industrial base can serve as a deterrent to potential adversaries. The ability to implement a concept called Graduated Mobilization Response (GMR), which

may be necessary to fight two major regional conflicts, is strengthened through maintaining a "warm" industrial base.

D. COSTS OF A DEFENSE INDUSTRIAL BASE

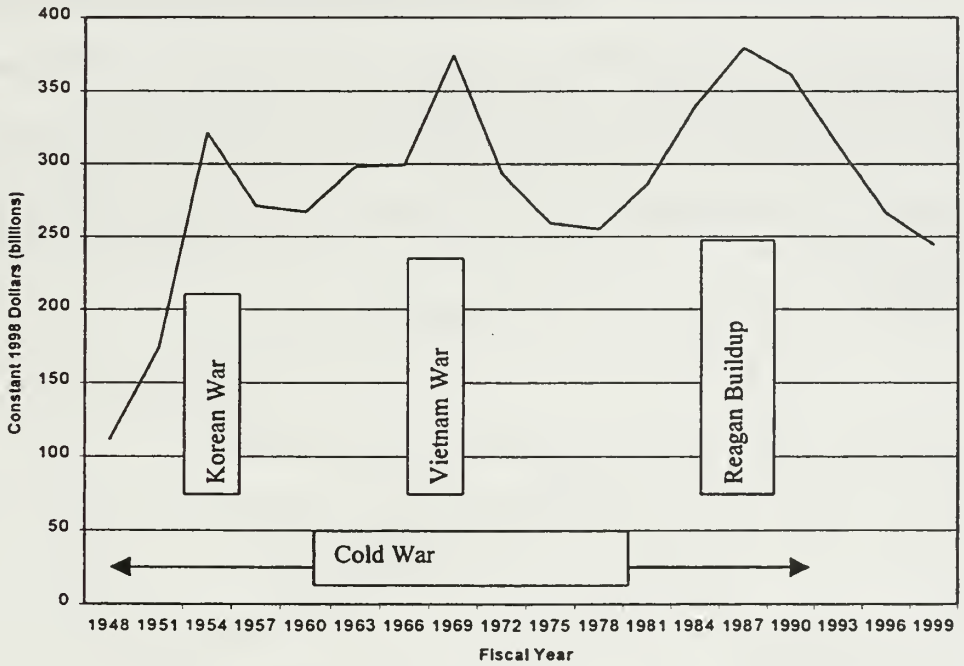
There is a lack of quantitative data on the cost of maintaining a defense industrial base. The cost of maintaining national independence may be a lack of interoperability with foreign suppliers in an alliance. [Ref. 3:p. 185] The cost of maintaining a capability which a Government believes will be required in the future could be measured in the purchase of an item not necessarily needed for defense but purchased to keep a production line "warm." For example, the Bush Administration, with the concurrence of the Pentagon and the Senate Armed Services Committee, proposed canceling the Seawolf submarine program. However, General Dynamics' Electric Boat Division and its subcontractors lobbied for the preservation of the program to maintain the capabilities needed to manufacture submarines and to preserve 25,000 related jobs. [Ref. 9:p. 15] In an op-ed piece in the Washington Post, Senator John McCain stated "Lacking any mission to justify its cost, the Seawolf is really nothing more than a jobs program." [Ref. 10:p. A31]

There are also costs involved in not using foreign suppliers. A sole-source domestic supplier can charge monopoly prices for spares and support. Reducing or eliminating foreign sources of supply may prevent the attainment of efficiencies driven by competition, resulting in overall higher life cycle costs. Foreign suppliers may also be members of a military alliance such as NATO where standardization and interoperability

are necessary. Members of the alliance could elect not to use the U.S. source and therefore there is a cost associated with interoperability among several suppliers.

E. DECLINING DEFENSE BUDGET

Downsizing after a major military conflict is not new. As depicted in Figure 2.1, there were significant downturns in defense spending after WW II, the Korean War and the Vietnam War.



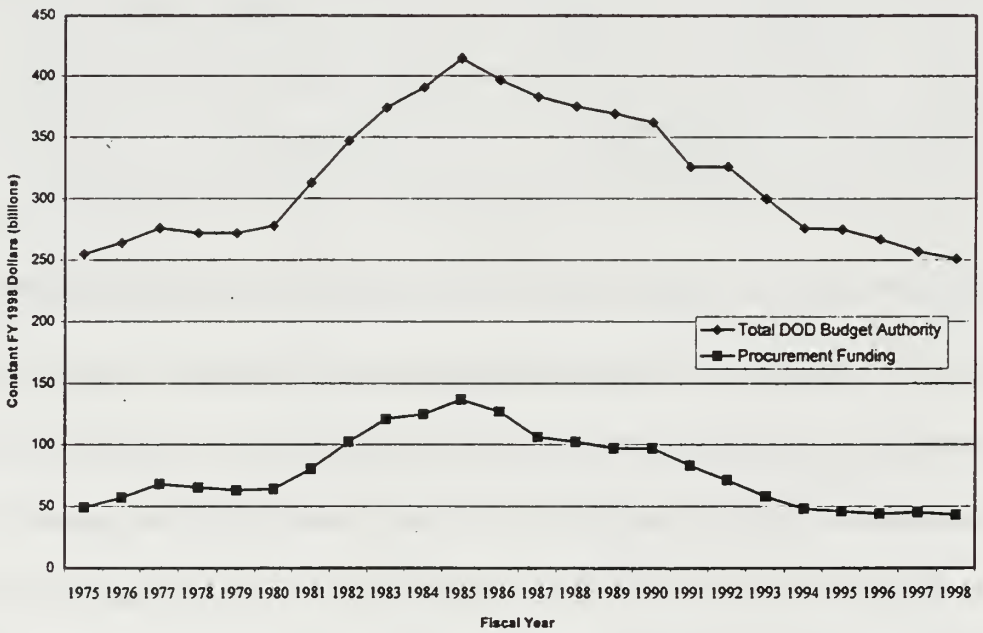
Source: Developed by the researcher using National Defense Budget estimates for FY 1998.

Figure 2.1. Defense Expenditures 1948-1998

There are several differences in the drawdowns however. In World War II the entire nation was mobilized to support the war effort. Later wars were more limited in scope and did not require total mobilization of the U.S. economy. In Korea and Vietnam the defense industry became more specialized from normal commercial production. The

major difference between the Vietnam drawdown and the recent one is that, in the former case, defense firms could simply opt to retrench and wait for the next defense buildup. The Soviet threat was still there and the Warsaw Pact arms buildup continued unabated. [Ref. 11:p. 53]

Over the last decade defense procurement budgets have been reduced even more dramatically than the overall defense budget. The decline in the procurement budget is normally cited as the reason for the consolidation and merger of defense companies. Indeed there has been a 67 percent drop in the procurement budget from the peak of $136.6 billion in 1985 (1998 dollars) to $42.6 billion in 1998 as illustrated in Figure 2.2. This latter number is less than half of the $95.2 billion spent on cigars and cigarettes annually. [Ref. 12]

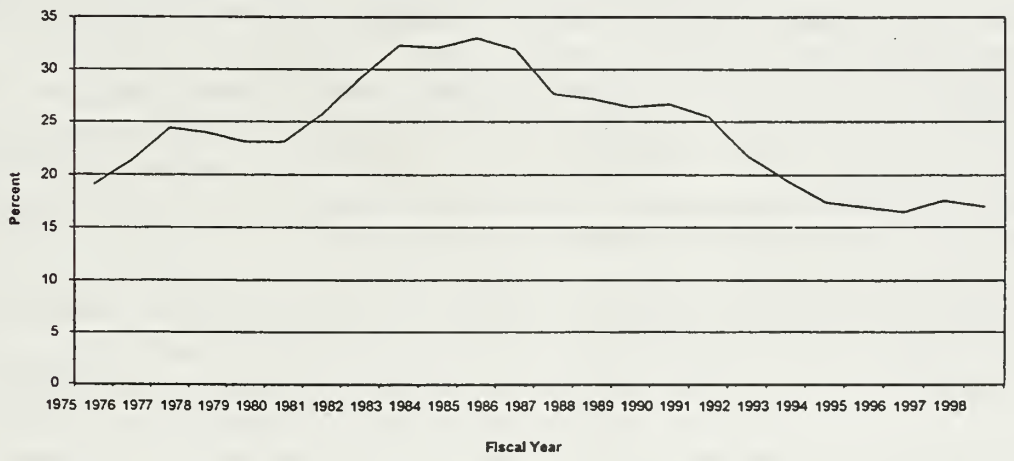


Source: Developed by the researcher using National Defense Budget estimates for FY 1998.

Figure 2.2. Total DoD and Procurement Funding

The decline in the procurement budget should be put in perspective. Studies of defense acquisition over the past 25 years reveal that major weapon systems often take 20 years to develop from concept to full production [Ref. 13]. If the procurement budget is measured over roughly the same period of time the decrease is not so dramatic. When compared to 1975, the last year of the post-Vietnam drawdown, when there was still a Soviet threat, the procurement budget has been reduced only twelve percent, from $48.6 billion in 1975 to $42.6 billion in 1998. [Ref. 14]

As illustrated in Figure 2.3, procurement as a share of the overall defense budget is now under 20 percent, a level not seen since the Vietnam drawdown. The reduced spending in procurement left many defense-related firms with excess capacity. By acquiring other firms or merging, defense firms reduced excess capacity and promoted more efficient operations.



Source: Developed by the researcher using National Defense Budget estimates for FY 1998.

Figure 2.3. Procurement Share of Defense Budget

Weapons have also become more reliable and lethal over the same period. As a result, lower quantities of a particular weapon are needed. It is possible that the strategy of using fever smarter weapons as opposed to large numbers of weapons fighting a war of attrition may have contributed to the reductions in the procurement budget.

F. MERGERS AND ACQUISITIONS

In the past eight years, the value of military mergers has increased dramatically. The Department of Defense has encouraged the consolidation and mergers. At a dinner, commonly referred to as the "Last Supper," with the executives from the defense industry in 1993, then Deputy Secretary of Defense William Perry informed those present that roughly half of them would soon be eliminated from the supplier base. [Ref. 7:p. 211] At the conclusion of World War II, the Pentagon purchased warplanes from twenty-six companies. Today the military has three companies to choose from: Lockheed Martin, Northrop Grumman, or Boeing. [Ref. 15:p. A21]

In 1991, mergers of defense related companies were valued at $300 million. From 1992 to 1997 a total of $55 billion in military industry-mergers took place. [Ref. 16:p. 1] On July 3, 1997 Lockheed Martin announced its merger with Northrop Grumman; both companies are products of mergers themselves. This was two days after the Federal Trade Commission approved Boeing's buyout of McDonnell Douglas Corp. and a day after the U.S. Justice Department approved Raytheon Corp.'s purchase of Texas Instruments' defense and electronics unit in a $14 billion deal. The combination of Lockheed Martin and Northrop Grumman would create a company with about $38 billion in revenue and 240,00 employees. In comparison, there are 174,000 Marines on active

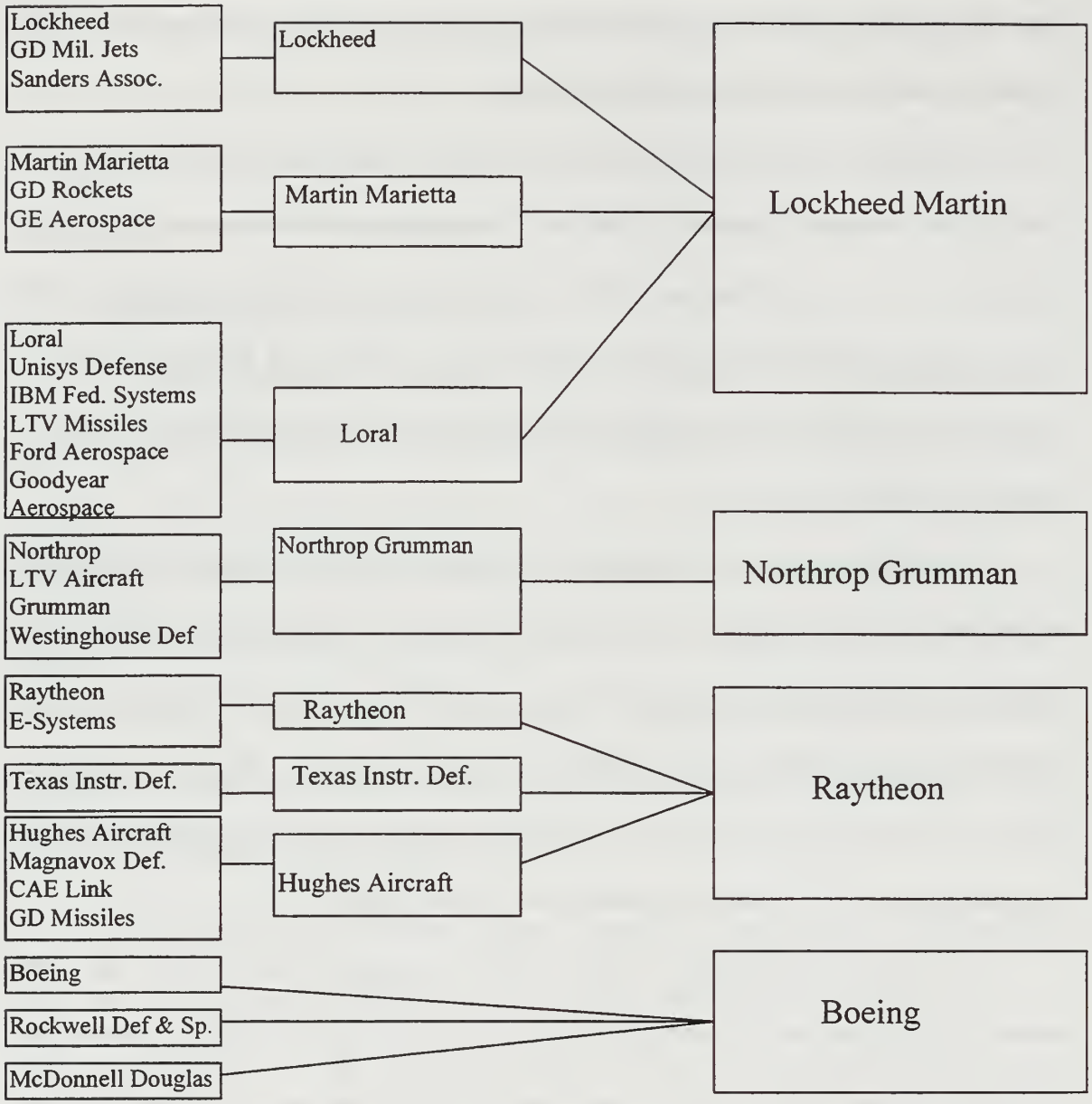
duty. Some major defense companies such as General Motors, IBM, and Rockwell, elected to leave the defense business altogether.

The Federal Government let market forces do most of the work rather than directing the mergers. An added incentive to consolidate was the allowance of firms to charge the cost of reorganizing as overhead to existing DoD contracts. On July 21, 1993 John M. Deutch, then Under Secretary of Defense for Acquisition & Technology, wrote a memorandum stating that restructuring costs are indeed allowable and thus reimbursable under Federal procurement law.

The Defense Contract Management Command (DCMC) had disallowed recurring restructuring costs in the past. As recently as the Bush Administration, DCMC had rejected a request by the Hughes Aircraft Corp. to be reimbursed for $112 million in costs resulting from its acquisition of General Dynamics. [Ref. 17:p. 24] The Aerospace Industry Association, perceived this as a change in policy rather than a clarification and requested notice of this change be posted in the Federal Register.

To recoup consolidation costs, defense companies must prove that the Government received savings in the form of reduced costs. In April 1993 a Government Accounting Office's (GAO) report found that this reimbursement policy has saved the Pentagon two dollars for every dollar it has spent. [Ref. 18:p. A15] Former Under Secretary of Defense (A&T) Kaminiski claimed that DOD reaped $3.95 billion in savings from efficiencies resulting from industry mergers. [Ref. 7:p. 211]

Figure 2.4 illustrates the mergers and consolidations. The dates and dollar values of the mergers are provided in Appendix I.



Source: Developed by the researcher.

Figure 2.4. Mergers and Consolidations in the Defense Industry 1990-1998

G. ANTI-TRUST IMPLICATIONS

Defense Secretary William Perry stated "We look at the proposed merger from the point of view of whether they are detrimental to our ability to maintain a

competitive defense industry, and if and when that happens, we'll speak out to the Justice Department. So far, however, that hasn't happened," [Ref. 7:p. 213] Perry's successor, William Cohen, is not as supportive of the consolidation as his predecessor. Meetings with Lockheed were held with both the Justice and Defense Departments in March 1998. After the meetings Lockheed stated that the Government was "fundamentally opposed" to its planned purchase of Northrop Grumman. [Ref. 16:p. 1]

H. TRADITIONAL MARKET SYSTEM

The ability of Congress to control what the end user receives whether the user wants it or not is a unique feature of the defense market. This differentiates DoD acquisition from the traditional market system.

In a traditional market place the seller of a product takes initiative in developing and producing a product. Funding required for development is obtained from retained earnings or through debt or equity financing. Buyers then decide to purchase the new product or one offered by a competitor. The market is the interaction between the buyer and seller. First, if a product does poorly against a competitor, the seller will use this information to lower prices, improve the product, or discontinue it. Second, the market serves as a reward and punishment system. Producers who anticipate consumer needs ahead of the competition and are efficient at keeping costs down will receive an above-average return. A producer neglecting to adapt to consumer desires or with poor cost control makes below-average profits or losses and may eventually be driven from the market. "Prices are determined by competition, not by costs incurred or determination of a fair level of profit." [Ref. 19:p. 55]

Competition between sellers ensures a reasonable price for the buyers. If profits increase, other sellers may be lured to enter the market. Decreases in profits may force some sellers out of the market in a search of greater return on their capital.

I. FREE MARKET VS. THE MARKET FOR WEAPON SYSTEMS

In a general sense the defense market is like any other market: it brings together buyers and sellers. The DoD and foreign Governments demand defense-related equipment and domestic and foreign industries supply the equipment. The parties are brought together through a legally binding contract by which the supplier, in return for a good or service, receives payment.

The market for a weapon system differs from the traditional free market. In the weapons market, the buyer decides what he wants developed. The buyer rather than the seller usually finances weapons. This is accomplished through cost invoices, loan guarantees, or advance payments. The buyer can also supply Government-owned property or Government-owned equipment to further reduce the investment required by the seller. Competition between sellers is not always based on price. During the early stages of a weapon acquisition program, competition may be centered on performance while cost may be a secondary concern.

The weapons acquisition market differs in how price is resolved. In a cost-plus contract, the price is ascertained by determining costs and then adding a "fair and reasonable" fee (profit).

Even in a negotiated fixed-price arrangement, sellers may have to certify cost data as current, accurate, and complete. The buyer then adds profit to anticipated or negotiated target costs.

Through market research firms can estimate demand for their products and plan accordingly. The cancellation of a product line is usually an internal corporate decision. In contrast, the market for weapons is subject to annual changes in the budget that may increase, decrease, or eliminate a program due to a policy change.

In his 1989 book, "Affording Defense" Jacques Gansler listed several areas where the weapons market and free market theory were different.

Table 2.1 gives Gansler's view of the practices in the defense market compared with the tenets of free market theory.

Table 2.1. Comparing Practices in the Defense Market Against Tenets of Free-market Theory [Ref. 11:p. 159]

Free Market Theory	Defense Market Practice
Many small buyers	One buyer
Many small suppliers	Very few large suppliers
All items are small, and bought in large quantities	Each item is extremely expensive, and bought in very small quantities
Market sets prices	Monopoly or oligopoly pricing – or "buy in" to "available budget dollars"
Free movement in and out of market	Extensive barriers to entry and exit
Prices are set by marginal costs	Prices are proportional to costs
Prices are set by marginal utility	Almost any price is paid for desired military performance
Prices fall with reduced demand to encourage buying more	Prices rise with reduced demand, owing to cost based pricing
Supply adjusts to demand	Large excess capacity
Labor is highly mobile	Greatly diminishing labor mobility
Decreasing or constant returns to scale (operating difficulty)	Increasing returns to scale (in region of interest)
Market shifts rapidly with changes in supply and demand	7-10 years to develop a new system, then at least 3-5 years to produce it
Market smoothly reaches equilibrium	Erratic budget behavior year to year
General equilibrium – assumes prices will return to equilibrium value	Costs have been rising at 5-7 percent per year excluding inflation
Profits are equalized across economy	Wide profit variations between sectors; even wider between firms

Table 2.1 (Continued)

Free Market Theory	Defense Market Practice
Perfect mobility of capital (money)	Difficulty in borrowing
Capital (equipment) is mobile with changing demand	Large and old capital equipment "locks in" companies
No Government involvement	Government is regulator, specifier, banker, judge of claims etc.
Selection is based on price	Selection is based on promised performance
No externalities	All businesses working for DOD must satisfy requirements of OSHA, EEO, awards to areas of high unemployment, small business set asides, etc.
Profits are a return for risks	Profits are regulated, primarily as a percent of costs
All products of a given type are the same	Essentially each producer's products are different
Competition is for share of the market	Competition is often for all or none of a market
Production is for inventory	Production occurs after a sale is made
Size of market is established by buyers and sellers	Size of market is established by "third party" (Congress) through annual budget
Demand is sensitive to price	Demand is "threat sensitive," or responds to availability of new technology; it is almost never price sensitive
Technology is equal throughout and industry	Competitive technologies
Relatively stable multi-year commitments	Annual commitments, with frequent changes
Benefits of the purchase go to the buyer	A "public good"
Buyer has a choice of spending now or saving for a later time	DOD must spend its congressional appropriation or lose it

Gansler's free market theory may confuse the term "free market" with commodity market in the table above. A more effective comparison would be between defense market practices and industrial market practices. In this case the markets are not as different as under Gansler's approach.

1. Number of Buyers

In the automobile industry, for example, there may be only one buyer for automobile bodies by Fisher Corp: General Motors. Many other companies sell exclusively to one buyer.

2. Barrier to Entry

The movement in and out of the defense industry may not be any more difficult than moving in and out of the industrial market. If barrier to entry is defined as a legal impediment to enter the industry, such as exists in local telecommunications markets, then there is no barrier to enter the defense market. If barrier is defined as economies of scale required to start production, then the same barriers exist for the automobile industry that exist for the defense industry.

3. Pricing

Pricing practices are also more similar between industrial markets and the weapons market. Procurement professionals now treat cost as an independent variable, trading off performance to obtain a better overall price. On the industrial market side prices are not set by marginal costs but by what the market will bear.

4. Mobility of Labor

The mobility of labor in the defense market may be equal to or greater than mobility in the free market. Fully one-fourth of the scientists and engineers involved in R&D move back and forth between civilian and defense work in a four-year period. [Ref. 20] Conversely, laborers in the auto industry enter into collective bargaining agreements where seniority matters most — a great disincentive for mobility.

5. Government Involvement

There is also extensive Government involvement in the automobile manufacturing industry. Requirements for airbags, fuel economy, and emission standards are a few regulations unique to this particular industry. The breadth and extent of the regulations may not be as great but, like all regulations, they modify behavior of the regulated party. The fuel-efficiency requirement, for example, encourages manufacturers to sell lighter and more dangerous vehicles on the market.

6. Production

Production for automobiles is primarily for inventory. However, consumers may request a range of options such as CD players, leather interiors, or special paint that will require modifications after initial production or delivery to the dealer.

J. CONTRACTING

Methods of contracting in the weapons market differ from those in the commercial market. In research and development contracts for weapons the product or task cannot be specified in detail and there are significant risks that cannot be identified. These risks are referred to as "unknown unknowns." The Government and a defense contractor will use a "cost-plus" contract in which a contractor is paid on the basis of cost incurred. The contract is for a "level of effort" rather than a particular product. A company entering a cost-plus contract must have a Government-approved cost accounting system.

The commercial market usually operates with fixed-price contracts. The costs and risks are known and the product or service can be clearly specified. The Government

will also use a fixed-price contract when a weapon system enters into production and risks are easier to define.

Table 2.2 shows the differences between traditional contracts and weapons procurement contracts according to Ganlser.

Table 2.2. Gansler's View of Traditional Business Contracts Contrasted with Weapons Procurement Contracts [Ref. 11:p. 162]

Traditional Contracts	Weapons Procurement Contracts
Fixed Scope (in terms of specifications, cost, performance, schedule, and quantities)	Constantly changing scope (in terms of specifications, budgets, desired performance, quantities and schedule)
"Arms-length relationship"	Involvement in every step of the process
A Change terminates or fundamentally alters the contract	Changes are treated as administrative matters, and appropriate adjustments are made to the contract
Results are easily measured, and blame is placeable	Results are hard to identify and measure. Placing blame is difficult because of the strong relationship[between buyer and seller]
What is bought is, basically, a product	Contract is as much for the service of producing the system as it is for the product itself(again reflecting detailed Government involvement)
Short term	Long term (often decades)
Disputes are litigated	Disputes are resolved by adjustments that preserve contractual relations

K. CHAPTER SUMMARY

This chapter provided three diverse topics. However, all of these topics are relevant and necessary to provide the reader with requisite knowledge. The first topic was the definition of the defense industrial base and its components. Maintaining a defense industrial base has costs as well as benefits. The benefits are self-sufficiency,

leverage, economic, and insulation from vulnerability to foreign sources. The costs are paying for excess capacity in peacetime, use of sole-source domestic suppliers when available foreign sources may be cheaper, and purchase of unnecessary equipment to keep production lines warm.

The second part of the chapter provided an overview of the declining overall defense and defense procurement budget with the latter now representing less than 20 percent of the former. The resulting decline in procurement spending, a 67 percent drop since 1985, has resulted in many defense firms merging or acquiring other firms. The consolidation of the defense industry was an effort by firms to eliminate excess capacity and become more efficient. The DoD encouraged and supported the mergers in order to benefit from the cost savings. In the Spring of 1998, DoD, was extremely concerned about a loss of competition in the industry, and no longer encouraged further consolidation. As a result of this fear, DoD sought to block the proposed merger of Lockheed Martin and Northrop Grumman.

The final section of this chapter presented Gansler's view of the differences between the traditional defense market and the free market. The researcher provided an analysis of the differences described by Gansler. Lastly, the final section presented Gansler's view of the differences between commercial and defense contracts.

Chapter III describes civil-military integration of the industrial base as a means of maintaining the desirable characteristics of a defense industrial base in an environment of reduced funding.

III. CIVIL-MILITARY INTEGRATION

A. DEFINITION OF CIVIL-MILITARY INTEGRATION

In one of his first speeches delivered after confirmation as the Under Secretary of Defense for Acquisition and Technology, Dr. Jacques Gansler stated:

> While the many mergers and acquisitions have been both necessary and desirable, there is a growing concern that we may end up with only sole-source producers in critical defense sectors – thus eliminating the innovation, cost, and responsiveness benefits of competition. A solution likely lies in a broadening of the defense industrial base to include commercial firms. [Ref. 21:p. 9]

The Office of Technology Assessment (OTA) defines civil-military integration as the process of merging the Defense Technology and Industrial Base (DTIB) and the larger Commercial Technology and Industrial Base (CTIB) into a unified National Technology and Industrial Base.

B. MEANS OF ACHIEVING CIVIL-MILITARY INTEGRATION

Civil-Military Integration (CMI) can occur through conversion of existing defense plants to commercial products, diversification of defense companies into commercial product lines, or dual-use technology where a single production line can produce both civilian and military components.

1. Conversion of Existing Defense Industries to Commercial Production

With the dramatic downsizing, defense conversion is seen as a way to avoid layoffs, plant closings, and business failures. In his 1992 paper "Converting the Defense Industry" Voss defined conversion as:

> The conversion of military capacity to civilian capacity. It implies that the company stops making some military products and changes over to civilian ones. People who were working on military projects then work on civil ones and factory facilities that were being used for military products are turned over to the civil workforce. [Ref. 22:p. 1]

2. Diversification

Diversification refers to a defense firm acquiring a commercial firm or starting a new commercial product line. It is an effort by a firm to reduce reliance on one particular market or customer. [Ref. 23:p. 91] "When defense contractors have successfully diversified, rarely has the source of competitive advantage rested on technology transferred from the military side of the business." [Ref. 24:p. A12]

3. Dual-Use

Experience has shown that most defense firms cannot convert from the high-overhead, "cost-plus" culture to compete in commercial markets. Another strategy for CMI is dual-use technologies. A key to pursuing dual-use technology was the passage of the Federal Acquisition Streamlining Act (FASA) in 1994. FASA makes it easier to buy commercial products and services. On February 24, 1994, Secretary of Defense Perry released "Acquisition Reform: A Mandate for Change." The Military Services were directed to "use performance and commercial specifications and standards instead of military specifications and standards." This was a reversal of the long-standing policy, which relied upon the use of military specifications and standards (MILSPECS) – the 31,000 specifications and standards that detail how military items are to be manufactured and tested. Dual-use technology refers to finding products or services that can have both

military and commercial applications. It is a two-way program to help defense firms enter the commercial market and commercial firms enter the defense market. Dual-use technology is defined in 10 U.S.C. 2491:

> Dual-use with respect to product services, standards, processes, or acquisition practices means products, services, standards processes, or acquisition practices that are capable of meeting requirements for military and non-military application.

C. JUSTIFICATION FOR AN INTEGRATED INDUSTRIAL BASE

According to the report "Second to None: Preserving America's Military Advantage Through Dual-Use Technology" prepared by the National Economic Council (NEC), an industrial base segregated into a defense sector and commercial sector is no longer appropriate for the following reasons:

1. Affordability

With the reduced budget it is no longer economically viable to have a completely separate military and commercial base. By integrating the two industrial bases DoD can exploit the market-driven efficiencies of the commercial sector. The inclusion of traditional commercial firms may help offset any loss of competition resulting from the defense mergers.

2. Access to Leading-Edge Technology

The defense industry is no longer in the position of technological leadership over the commercial sector. Technologies most needed to support the revolution in military affairs such as computers, semiconductors, telecommunications and advanced materials are being advanced by commercial demand, not military demand. CMI will allow the

Pentagon to take advantage of the rapid pace of innovation and efficiencies of the commercial sector.

3. Ability to Rebuild

A smaller defense-only industrial base may not have the capacity to quickly respond to a crisis. With CMI the manufacturing capacity of the entire nation could be used without a lengthy process of retooling and build–up.

D. OBJECTIVES OF AN INTEGRATED INDUSTRIAL BASE

The objectives of civil-military integration are to shorten weapon system development time, reduce costs, and maintain capacity to respond quickly to a crisis. These objectives are summarized as follows:

- Shorten weapon system development time and increase the pace at which technological improvements are incorporated into new military systems. This goal can be accomplished by introducing the commercial sector's continuous stream of updated technology during development, production and deployment phases.

- Reduce costs for procuring leading-edge technology. Commercial components, technologies and subsystems can, in many instances, be incorporated into military systems to meet the functional requirements at lower cost than technology that is uniquely developed from scratch for a specific military customer.

- Permit DoD to maintain its ability to respond to national security contingencies. Close integration with the private sector is imperative if the nation is to be equipped to gear up its industrial capabilities quickly to meet the military demands of a crisis. [Ref. 25]

E. STRATEGY TO ACHIEVE OBJECTIVES

The Pentagon built upon acquisition reform, with a goal to make the acquisition process more businesslike, by pursuing the dual-use strategy. Dual-use is accomplished

through: (1) support for research and development (R&D), (2) integration of defense and commercial products and (3) insertion of commercial technologies in development, production and support of military systems. [Ref. 26]

1. Support for Research and Development

The Pentagon funds dual-use R&D to take advantage of advanced commercial techniques through the Defense Advanced Research Projects Agency (DARPA). DARPA targets investments in areas such as computer hardware, software, electronics and simulation that have defense applications as well as commercial applications.

In 1993, the Technology Reinvestment Project (TRP) was established with an investment of $440 million. It allowed DARPA to match each TRP dollar with a contributor's dollar. This cost-sharing arrangement gave DoD access to commercial research with minimal investment. According to Robert Hertzfeld, Acting Director of the Dual-Use and Commercial Program Office in the Pentagon, "The funding gives DoD leverage. By using a cost-sharing arrangement the DoD benefits from all the technology the firm brings to the project." [Ref. 27] For example, if a firm has already spent $100 million on a given technology that DoD is interested in and for which there may be a military application, then DoD and the company may split the cost of developing the military application. If the cost to develop the military application is $20 million and DoD pays a $10-million share, then it has leveraged $10 million into $120 million worth of research by pursuing a commercial technology.

Table 3.1. Demonstration of Leverage

Funds previously spent on research by commercial firm:	$100
DoD share of development for military use:	$ 10
Commercial firm share for military use:	$ 10
Total spent on technology:	$120

The following are examples of Dual-use R&D

Low-cost night vision systems.

Use of commercial research and technology made infrared sensors one-tenth the cost of their MILSPEC counterparts. [Ref. 28]

Battlefield casualty treatment.

Sensors and information systems placed in uniforms can improve ability to diagnose and treat injured personnel. [Ref. 29] Information can be relayed immediately after the injury from the field to a medical facility staffed with specialists.

Composite materials.

The use of materials lighter than metal yet stronger will increase the performance and range of aircraft. Brunswick, best known for its bowling balls, also makes composite materials for aircraft radar domes and pressure vessels for space.

2. Integration of Defense and Commercial Production

Integration of defense and commercial production can be accomplished in either of two ways. First, a commercial application for defense technologies can be found to make production more affordable through economies of scale. Second, flexible manufacturing can be promoted so custom military products can be produced on the same assembly line as commercial products with minimal retooling. Flexible manufacturing

refers to the ability of a firm to manufacture different items off the same assembly line with a minimal number of changes or retooling. The following are examples of defense and commercial production:

Global Positioning Systems (GPS).

GPS was designed to help the military locate targets or allow military units to determine their precise location by the use of satellites in geosynchronous orbit. A commercial use was developed for merchant ships and commercial aircraft. During Desert Storm the Army required a large number of global positioning systems. The MILSPEC receiver cost $34,000, weighed 17 pounds and would have taken 18 months to procure. An acceptable commercial GPS weighing three pounds was purchased for $1,300. The cost of the commercial unit is now $800. [Ref. 28:p. 12]

Circuit Boards for F-22 Aircraft.

TRW manufactures circuit boards for the F-22 stealth fighter on the same high-volume production line as the circuit boards for commercial trucks. The challenge in the flexible manufacture of these circuit boards is not switching from commercial to military production, but working around the traditional contracting process in order to accomplish the change. [Ref. 28]

HS601 Satellite.

Another example of integrated production is Hughes Aircraft. For the HS601 satellite Hughes set up three separate program offices, one each for the DOD, National Air and Space Administration (NASA), and commercial customers. However at the engineering and manufacturing divisions, interchangeability and commonality among

projects is emphasized. Manpower at these two divisions is interchangeable among the three programs. The satellites had common propulsion, power systems, altitude control sensors, digital computers and structural members. "All the spacecraft were built by the same standard, independent of customer, contracting method, and level of in-plant inspection." [Ref. 30] The power demands of the radio subsystems for each customer were different so the HS601 can be expanded off the existing structure, similar to adding LEGO™ blocks to each other. The military configuration requires additional solar panels and plates for batteries while the commercial customer may elect not to add additional panels or plates. The HS601 was sold to Australia for mobile communication service and direct TV broadcast service while the second unit manufactured was sold to the U.S. Navy for tactical communications among air, sea, and land forces. [Ref. 31]

3. Insertion of Commercial Technologies and Products into Military Systems

Although FASA eliminated regulatory barriers to buying commercial items, the risk of departing from MILSPECS must be considered. Commercial products must be able to perform in a military environment that may be more stressful on the component or system than a commercial environment. If the risk is low and substitution possible, then commercial units will generally be less expensive. "Ultimately, successful insertion requires that a weapon system be designed from the outset to incorporate commercial rather than defense-unique materials, technologies, and components, with cost and manufacturing treated as key considerations." [Ref. 28]

F. METHODS OF ACHIEVING COMMERCIAL MILITARY INTEGRATION

There are three initiatives for achieving commercial military integration: Dual-Use Science and Technology, (Dual-Use S&T), the Commercial Technology Insertion Program (CTIP), and the Commercial Operating and Support Savings Initiative. (COSSI)

1. Dual-Use S&T

Dual-Use S&T is primarily accomplished using a tool called "Other Transactions Authority (OTA)." In 1990, Congress authorized a $50 million appropriation under 10 U.S.C. 2371, Section 845 of Public Law 103-160, Other Transactions Authority (OTA), for DARPA to fund dual-use programs for certain prototype projects, to the military departments and other designated officials. This new statutory authority provides relief from most procurement regulations such as the Federal Acquisition Regulation (FAR), Defense Federal Acquisition Regulation Supplement (DFARS), or other laws and regulations specific to the procurement process. Statutes of general applicability such as equal opportunity, Vietnam Veterans and handicapped workers, however are applicable. DoD designated the defense agencies as authorized users of this authority.

Under OTA, DARPA may enter into other transactions with any "person, agency or instrumentality of the U.S., unit of state or local Government, educational institution, and any other entity." [Ref. 32:p. 34] The advantage of using OTAs is the regulatory relief provided. OTAs enable the Government to negotiate terms and conditions of a business arrangement unconstrained by rules and forms that are unique to Government.

The Government may also enter into agreements with consortiums of several companies, which would not be allowed under existing procurement regulations.

2. Commercial Technology Insertion Program (CTIP)– Reducing Operation and Support Costs

Commercial Technology Insertion takes advantage of new commercial technologies that are available while a weapon system is in the development or upgrade stage. The use of rapidly developing commercial technologies should improve the performance, affordability, and delivery schedule of weapon systems at this stage of the acquisition cycle. As a weapon system moves closer to production, changes become risky and program managers may not wish to jeopardize the production schedule.

CTIP therefore is targeted at introducing new technologies during the Engineering and Manufacturing Development (EMD) phase of an acquisition program.

3. Commercial Operations and Support Savings Initiative (COSSI)

About 65-70 percent of the life cycle cost of a major weapon system is incurred after the system is fielded. [Ref. 33] As systems age, operation and maintenance (O&M) costs tend to grow. With the funding for defense spending remaining steady, a key to modernization is to reduce O&M costs.

The Commercial Operations and Support Savings Initiative (COSSI) is an attempt to reduce O&M costs by developing repair and upgrade kits and incorporating technological upgrades that occur as the system ages and inserting those kits in fielded systems. It utilizes OTA for the first stage and standard procurement practices for the second.

> COSSI is a two step process. In Stage I, DoD and a firm or consortium enters into a cost sharing arrangement to develop and qualify a prototype repair or upgrade kit. Cost sharing provides assurance that the industry partner is committed to the project and believes in the viability of the outcome. Stage II is implemented where Stage I has been successful. In Stage II, the military customer can use normal procurement procedures to purchase production quantities of kits. [Ref. 33]

COSSI was implemented in FY 1997. After the first year of the program, eighty-one proposals were evaluated and thirty were selected for Stage I funding. The Government share of the funding was $91 million, with the commercial firms contributing $97 million. According to Secretary of Defense Cohen, if all thirty Stage I projects proceed to Stage II, the net present value of O&M savings these projects are expected to generate over a ten-year period is approximately $3 billion.

COSSI does have some problems. Funding for COSSI in FY 1998 was provided only incrementally to existing programs and new programs will not be started until funding becomes available in FY 1999. Another characteristic of COSSI is that companies that participate in Stage I are treated as "sole source" bidders when they enter Stage II and use normal procurement procedures. At this stage all FAR clauses apply and a directive will have to be issued authorizing “less than adequate competition” for the Stage II request for proposal. [Ref. 34]

The three programs established for achieving CMI are: dual-use S&T, CTIP, and COSSI. Dual-use S&T uses OTA and takes place in the research phase of an acquisition program. Once an acquisition program is in the development stage the CTIP hopes to improve cost, performance, and schedule. When a weapon system is in production or

fielded, the commercial operations and support savings initiative is used to develop upgrade and repair kits to insert in fielded systems. The primary goal of COSSI is to reduce operations and maintenance costs. Figure 3.1 illustrates the various initiatives discussed and the acquisition milestone in which they will be used. The milestones are defined in Appendix II.

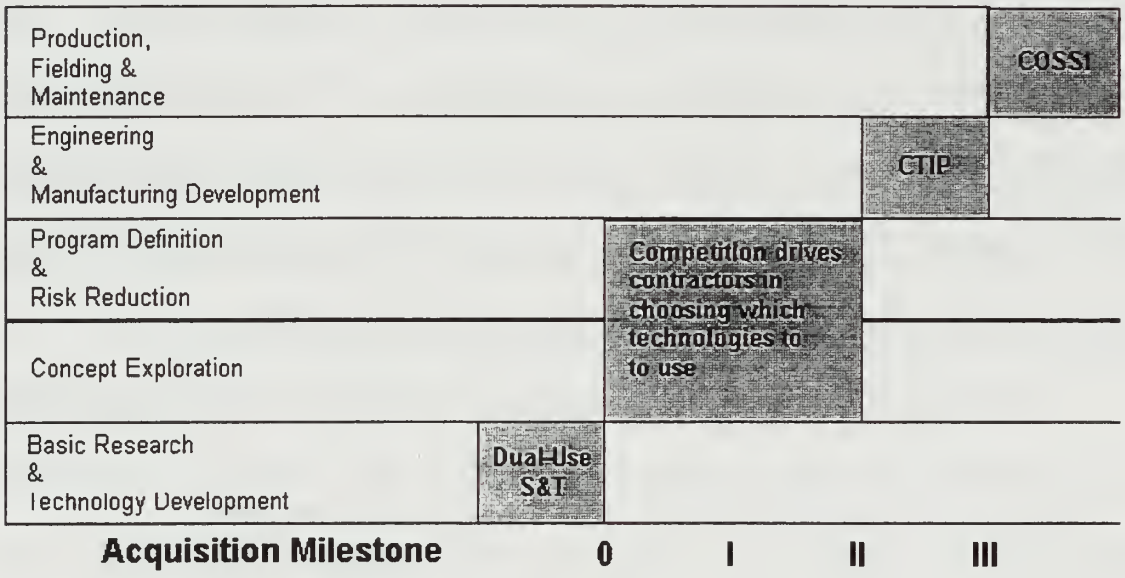


Figure 3.1. Current Initiatives Promoting Civil-Military Integration [Ref. 35]

G. CHAPTER SUMMARY

This chapter defined CMI as the process of merging the Defense Industrial Base to the Commercial Industrial Base. Conversion, diversification and dual-use initiatives are the means of achieving CMI. The justification and objectives for an integrated industrial base are affordability, access to leading edge technology, and ability to meet surge requirements in emergencies. The strategies to achieve the objectives of CMI are:

support for R&D, integration of defense and commercial production, and insertion of commercial technologies and products into the military systems. Currently DoD is using several methods for implementing the strategies. The first, Dual-use S&T, is targeted at research early in the acquisition process. Second, the commercial technology insertion program places commercial components into a weapon system during the development stage. The third method is the commercial operations and support savings initiative. The commercial operations and support savings initiative is a two-stage process geared to insertion of repair or upgrade kits to fielded systems. It uses OTAs for the first stage and standard procurement methods for the second.

IV. ADVANTAGES AND DISADVANTAGES OF CMI

A. INTRODUCTION

This chapter presents the advantages and disadvantages of pursuing CMI. Both the positive and negative aspects are presented whether they were found at the policy level of determining who will benefit from CMI, or the end-user level in discussing product support and reliability.

B. NEGATIVE ASPECTS OF CIVIL-MILITARY INTEGRATION

1. Defense Cuts and Conversion Markets

Defense conversion appears as a win-win situation. The technology base of defense suppliers is sophisticated and helping the defense suppliers convert to commercial enterprises should therefore help the overall economy. However the facts say otherwise. "The markets for typical conversion products – like wind shear detectors and night vision equipment – are minuscule compared with the Pentagon's former defense needs." [Ref. 24] In other areas such as data services and electronic controls the defense-based technology is not new and established competitors already exist. As a result most attempts at conversion are not successful.

2. History of Failure

The history of defense firms converting to or entering the commercial market is one marked by failure. The inability of many defense firms to enter the commercial market was caused by unfamiliarity with commercial work, concurrency (concurrency is the simultaneous and integrated engineering of all design, manufacturing and support

aspects of a product from concept through availability [Ref. 36:p. 18]), and inaccurate market expectations.

In the case of developing light rail vehicles for urban mass transit, Boeing underestimated difficulties present, and agreed to compressed delivery schedules. The schedule, coupled with penalties for late delivery, forced Boeing to meet milestones through concurrency - modifying the cars on the production line. [Ref. 23:p. 103] This resulted in 65 design modifications within the first year of operation. At the end of the second year, only 39 of 175 rail cars delivered were in revenue service. [Ref. 23:p. 104] Boeing officials admitted concurrency was a mistake and that the problems may have been avoided had they shut down production, paid the scheduling penalties, and completed design modifications prior to moving into full production. [Ref. 23:p. 103]

Although many firms such as Boeing have both commercial and military product lines, their defense business is usually separated from the commercial business geographically, financially, and technically. "The only link between their defense and commercial sectors, literally two distinct businesses, is that they both report to the same corporate headquarters." [Ref. 37:p. 243] The successful companies segregate the commercial operations, design, procurement, manufacturing, service, marketing, and sales from similar Government divisions to avoid mixing the two businesses even if the products are related. [Ref. 24:p. A12]

The list below summarizes the unsuccessful attempts at defense conversion or diversification:

- Boeing – buses and electric trains for urban mass transit.
- Avco (now a part of Textron) - filmmaking, motor-home construction and VCR production.
- Grumman – buses, yachts, and solar panels.
- Northrop – pollution controls, nuclear-plant equipment, medical and business data services, and airport development.
- McDonnell-Douglas – microelectronic controls, medical systems, real estate and coal conversion.
- Martin Marietta – energy and environmental services.
- Raytheon – data terminals, television tubes, and semiconductors.
- TRW – telecommunications.
- General Dynamics – telecommunications.
- Acurex – solar energy.

According to Lundquist any conversion ventures backed by Government funds should be assessed on the small chance that they would be successful. The more unfamiliar the market the higher the likelihood of failure. This results in many defense contractors seeking overseas markets rather than converting or diversifying their operations.

A common link among the failures was that the new markets were still closely tied to the Government, in particular through Government goals such as increased mass transit and use of alternative energy.

3. Determining Who Benefits

If the Government supports or subsidizes a dual-use initiative, one problem may be identifying who will benefit the most. The military should initially benefit. Having a

larger national industrial base (NIB), as opposed to a DIB, should create greater competition and greater surge capabilities in time of conflict. Commercial or traditionally non-defense related firms would also benefit by having an expanded market.

The greatest cost may come to the traditional defense contractors however. For example, a traditional defense firm pursuing dual-use technologies may face restrictions on which technology or product it is allowed to provide to the commercial market, especially items that could be exported and used by hostile nations. If the firm counted on its potential revenues from commercial sales to help cover its development costs then it may lose money on the dual-use venture. Additionally, traditional defense firms will face increased competition from the commercial sector after operating in a somewhat insulated market. Defense contractors' competitors are already familiar with marketing in both the domestic and international market. This increased competition will exist in a shrinking defense market, further exacerbating the problem for traditional defense contractors.

> The Government dual-use programs will in the short run, hurt the firms they were designed to help. In the long run (for those that survive), defense firms will be far stronger and more competitive in the converging defense and commercial markets. [Ref. 37:p. 240]

4. Standardization

Military specifications do have advantages over the use of commercial items. They enable several different manufacturers to produce an item that is interchangeable with an item from another manufacturer. Another reason cited for use of MILSPECS is that specifying a brand name for an item may appear to restrict competition; however, any item that meets the MILSPEC is acceptable. Buyers are then assured of functionality, regardless of the source selected. [Ref. 38:p. 46]

The use of standards allows a contracting officer or contractor to narrow the area of judgment for a product. [Ref. 39:p. 39] MILSPECS also provided designers a "pool of standardized components" to choose from. [Ref. 38:p. 46]

In the commercial market, designers and manufactures continuously seek to differentiate their products from other suppliers. The product can then be marketed as better than the competitor's by being faster, lighter, smaller, cheaper or whatever a company believes the market wants.

The Joint Electronic Device Engineering Committee (JEDEC) sets standards on electronic components. Many firms will use JDEC criteria as their minimum criteria and then deviate from that. For example, in the integrated circuit there is a JEDEC criteria for transistor-transistor logic (TTL) called the 74 series. The 74 series now comes with 74, 74C, 74H, 74HC, 74AHC, 74S, 74LS, 74ALS, 74F, 74ABT, 74LV, 74LVC, 74LVT, and 74ALVC. "Common logic families are now filled with so many variations that procurement has been seriously compromised." [Ref. 38:p. 46]

5. Product Support

Product support for the Defense Department can be reduced under civil-military integration. According to Dr. Gary Gaugler, a senior engineer at the Defense Microelectronics Activity (DMEA), many chipmakers have stopped producing semiconductors for military customers. As a result several designs suddenly lost their spare parts and production parts streams. For example, on the F-22 the electronic prototype systems built for initial demonstration cannot be produced. The original microelectronic components made by LSI Logic, Milipitas, CA are no longer available. LSI Logic discontinued all military gate array business. As a result the designs made by the prime contractors for avionics in the avionics systems are no longer available. They

will have to be redesigned, re-hosted, re-manufactured, re-tested, and re-qualified. [Ref. 40]

A second issue also involving the F-22 is that the electronic system was built around a 5-volt power supply standard. Nineteen Ninety Eight marks the first year that 5-volt devices are less than 50% of the total production of microelectronic devices. One hundred percent of military systems run on 5 or higher volt systems. Commercial systems by contrast run on 3.3 or 2.7 volts of electricity. The percentage operating at 5 volts will go down exponentially over time. [Ref. 40] Higher speed, higher density and lower unit cost dictate the use of smaller microelectronic devices. "As the industry moves towards 0.35, 0.25 micron and smaller devices, the operating voltages move correspondingly lower." [Ref. 40] Lloyd Peters, a senior analyst with SRI International, believes that "the military needs to focus on system architectures so that electronic systems can be upgraded as better components are developed instead of focusing on individual pieces of equipment and being forced to make obsolete parts." [Ref. 41]

6. Reliability

There is a common perception that commercial items will not withstand the rigors of military use. Whereas commercial semiconductors are made to function at temperatures from 32 degrees Fahrenheit to 158 degrees Fahrenheit, military electronic components are designed to operate at temperatures ranging from minus 67 degrees Fahrenheit to 257 degrees Fahrenheit. [Ref. 40] The temperature inside a weapon-system platform at approximately 80,000 feet could reach –40F while in a container in the desert may reach 170F. At forward air bases such as Elmendorf AFB in Alaska,

aircraft would have to remain in climate-controlled hangars or aircrews would have to wait while the avionics reached a certain operational temperature window.

An example cited by opponents of CMI is a MILSPEC fax machine designed and manufactured for the Air Force that "withstood blowing sand and kept transmitting target imagery while the cases melted off its commercial counterparts in the desert heat." [Ref. 42] Sutton described the fax machine example as proving the rule by citing the exception. Dr. Gaugler counters that if you have a hypothesis that commercial products can work or be integrated in military weapons platforms you only need one exception to disprove the hypothesis.

The reliability issue is addressed during test and evaluation. "Program Managers will test a commercial component in a platform under the same conditions that the platform would be operating in. Until a component completes the formal test and evaluation process a Program Manager would consider it untried and untested." [Ref. 43] If commercial items and MILSPEC items are subjected to the same tests and pass, there is no reason to believe that a MILSPEC item is more reliable.

7. Reliance on Foreign Sources

High-tech markets cross national boundaries. In 1970, 95 % of high-tech products purchased by Americans were made in the United States; by 1986, this fraction had fallen to 82%. [Ref. 31] High-tech is defined as any technology requiring the most sophisticated scientific equipment and advanced engineering techniques. [Ref. 44] Heavier reliance on commercial products could therefore result in increasing dependence on foreign products.

Current policy at the DoD Office of Industrial Affairs is that foreign sourcing or dependency on foreign sources is not a problem. The DoD recognizes that it operates in a global marketplace. "The Pentagon asks the question 'Will it meet our needs?' We [the Pentagon] are indifferent to who manufactures what." [Ref. 45] Dependency is different from vulnerability. The Pentagon Office of Industrial Affairs and Capabilities focuses more on vulnerabilities to interrupted supply than in monitoring the total amount of material obtained from offshore suppliers.

8. Technology Transfer

One of the major disadvantages of civil-military integration is the loss of controls over technology. With commercial technology advancing faster than military-unique technology, other countries can obtain state-of-the-art systems and components and insert them into military platforms.

On one side of the issue are the contractors who want fewer restrictions on exporting items such as satellites. However, exporting satellites with dual-use technology may violate laws concerning the exportation of technology with military applications.

In a recent case President Clinton, after being lobbied by the industry officials, approved the export of a Loral satellite. The Pentagon found that the reliability of China's nuclear missiles was advanced after American scientists provided expertise on how to put a commercial satellite in orbit. "The technology needed to put a commercial satellite in orbit is similar to that which guides a long-range nuclear missile to its target." [Ref. 46]

The technology can be difficult to control. Makers of these highly specialized systems no longer have a large domestic customer to sell to and increasingly must turn to the global market. The smaller defense market benefits as well from the economies of scale. If a country, such as China, is considered friendly, then the controls are less restrictive. The weakness is in the fact that once the technology is transferred to a friendly nation it in turn can provide the technology to a hostile country. For example, China, a country receiving "most-favored-nation" trade status, has sold missile technology to Iran.

U.S. law requires foreign purchasers of firearms to sign a statement that arms will not be re-exported to another country without the authorization of the State Department. However, even friendly trading partners such as those in the European Union believe that "re-export restrictions are an infringement on territorial sovereignty." [Ref. 47] Under European Union law there is no requirement that a company wishing to re-export goods, military or commercial, to another member country notify the export licensing authority in the original country. [Ref. 47]

The current administration believes that economic security is an integral part of national security and supports many of the high-tech exports. At former Secretary of Defense William Perry's confirmation hearing on Feb 24, 1993, Perry said that controlling the sale of dual-use technology "was a hopeless task, and that it only interferes with a company's ability to succeed internationally if we try to impose all sorts of controls in that area." [Ref. 48]

9. Training Acquisition Personnel

Acquisition professionals have been trained to perform in a unique procurement environment. "Training costs may rise as a result of the elimination of the established military specification and standards system." [Ref. 25:p. 31] After years of learning the importance of MILSPECS, quality assurance, cost accounting, and risks of fraud it will be difficult to tell them that commercial practices are acceptable and may be better.

10. Quality Assurance

With integration lower-quality products may find their way into the supply system. A system failing in combat may have fatal consequences. (However even with MILSPECS this risk remains. Some MILSPEC items are commercial products downgraded as the commercial standards are higher).

11. Fraud and Abuse

The DoD Inspector General, Eleanor Hill, fears that eliminating requirements for cost and pricing data and cost accounting standards may result in greater fraud and abuse. [Ref. 49:p. 28]

12. Technical Data Rights

In most cases, DoD requires its suppliers to provide technical drawings and data that may be provided to a seller's competitors to promote competition. In contrast, commercial firms protect their proprietary information closely. Any dual-use arrangement will have to address limitations on the Government's rights to technical data and safeguards to prevent the release or unauthorized use of proprietary data.

13. Socioeconomic Programs

One of the purposes of Government procurement is to promote socioeconomic goals such as providing set asides for small disadvantaged businesses, restricting sources, and directing contracts to labor surplus areas. The less control or leverage the Government has over an industry, the less influence it has in promoting these goals. Commercial firms may decline to set aside a percentage of their subcontracts for "small disadvantaged businesses" in order to win Government business especially if the Government business is not vital to its profitability.

14. Leverage

The DoD is no longer the dominant customer for most high-technology firms. As the commercial market for semiconductor swells, DoD becomes a diminishing force in the market. Now the U.S. Government represents about one percent of the total semiconductor market, and has less influence on an industry's research effort. [Ref. 41] "Restructuring the DIB to take maximum advantage of CMI may gain economic efficiency at the price of technological superiority." [Ref. 25:p. 41]

C. BENEFITS OF CMI

1. Administrative Costs

A study conducted by the Center for Strategic and International Studies (CSIS) examined real-world cases to try to quantitatively determine potential savings through civil-military integration. The study examined a company with annual commercial sales of $10 billion and defense sales of $4 billion; the total workforce of the company was 100,000 employees. The CSIS study found that 8,500 employees were needed to administer the commercial sales and 18,200 to administer the defense sales. If the

commercial ratio of employees to dollar of sales was applied to the defense sales it would result in a savings of approximately $750 million out of the $4 billion in annual sales.

These savings were only in direct labor. Correspondingly there would be savings in reduced oversight from Government employees and reduced overhead. In the same CSIS study IBM estimated that 26 percent of the cost of the avionics processors it builds for the DoD resulted from defense-unique requirements that added no [performance] value to the final product. Buying commercial items results in lower prices because the development costs of commercial items have been allocated to the expected commercial market sales. [Ref. 50]

2. Direct Costs

The low volume for defense orders results in higher per unit cost. Commercial components and technologies can meet the military's needs in many instances. These commercial products and technologies can be provided cheaper than technology or products custom developed for the military. [Ref. 43]

3. Reduced Time

Using existing technologies can reduce the time required to proceed through the acquisition process. The technologies may already be proven and on the shelf. Time savings are obtained through less development on Government time, less testing, no need for unique Government training or technical manuals, and, if it is a purely commercial item, less cost and price analysis. "Although DOD R&D programs deal with state-of-the-art technologies, the pace at which technology actually moves into production trails well behind the rapid rate of new product development by commercial industry." [Ref. 28:p. 7]

"Buying commercial items makes it possible to tap quickly into innovative technologies developed for commercial sales, and it also provides the program/project office with an assurance that the item will meet the specified performance standards because it exists before contract award and can be observed and treated." [Ref. 50] A Defense Science Board study found that systems built with commercial components could be purchased in 20 to 50 percent of the time required for purchasing systems made from unique military products. [Ref. 51]

4. Competition

By using the commercial market place, the Defense Department would obtain the benefits of competition, innovation and lower prices. The commercial marketplace is now considered more technologically innovative, and competitive markets are more price-responsive than monopolies.

An example of using the threat of competition to the Government's advantage was the C-17 program. The program had a history of delays, technical problems, and cost overruns. "The Government had dozens of auditors pouring over records at the prime contractor, McDonnell Douglas, in an effort to get a handle on the program." [Ref. 52] The Air Force then threatened to take an offer from Boeing for a reconfigured but less expensive Boeing 747. McDonnell-Douglas then found a way to get costs under control, cutting the price of every C-17 by one-third, approximately $200 million per plane.

Competition is important for innovation as well as lower prices. "The Rand Corporation found that the most important breakthroughs in military technology have not come from the one or two companies that were incumbent contractors in a category, but from 'wannabes' and upstart firms hoping to challenge them." [Ref. 52] The example

cited in the report was the breakthroughs in stealth technology developed by Northrop and Lockheed, which at the time did not have prime contracts for any Air Force fighters.

5. Technology Transfer

Military technology was once the leader in innovation. However, in the past decade commercial firms have been considered the leaders in technological innovation. Currently, more than 92 percent of research-oriented firms perform insignificant or no Government research and development. [Ref. 53]

When the Annual Business Week R&D Scoreboard of the top 900 R&D performing U.S. firms is compared to the Department of Defense report on the 500 largest R&D contractors, less than ten percent of the top 900 firms appear on the DoD list. Of these, more than half are major defense contractors. [Ref. 53]

The following industries invest more than 5.3% of sales back into R&D: computer communications, computers, data processing, disk and storage tape drives, drugs, electronics, instruments, medical products, peripherals, semiconductors, software, and systems. Not one of the top three firms in any of the twelve categories appeared on the DoD list. [Ref. 53]

"Now instead of "spin-offs" from military technology, we are seeing "spin-ons" where the military is looking to technologies from the more advanced private sector." [Ref. 54] Recognizing this trend/opportunity, the USD (A&T), Jacques Gansler, is investigating the use of fixed-price development contracts to entice non-traditional defense contractors to bid on DoD contracts. [Ref. 55]

Civil-military integration will allow DOD to gain access to leading-edge technology and enable the military to insert this technology not only during the

development stage but also once a system is fielded. "The biggest potential for use of commercial items is in electronic components, software, and advanced materials." [Ref. 43] Both electronic components and software have the commercial sector leading the defense sector in innovative research.

6. Leverage

U.S. defense spending on R&D has grown about 50% since 1960. By comparison, commercial spending on R&D in the U.S. has grown by 400% over the same period. [Ref. 31]

Although Federal R&D is declining relative to the overall national R&D budget, it is still a significant part of the discretionary budget. More than half of the Federal budget is now spent on non-discretionary expenditures such as social security, Medicaid, and interest on the national debt. The remaining items such as the defense budget are discretionary and must be approved annually. Of the total R&D budget, defense R&D is the largest component followed by health.

The breakdown of R&D into various categories must also be reviewed. If R&D is divided into basic research, applied research, and development, there is a significant difference between the distribution of funds in the commercial and military sector. Defense R&D is two percent basic research, seven percent applied research, and 91 percent development; conversely self-financed industrial R&D is six percent basic research, 25 percent applied research and 69 percent development. [Ref. 31:p. 106] With defense R&D shrinking compared to total commercial and Government R&D, and only a portion being used for basic and applied research, leverage becomes important.

Commercial R&D is now leading the technological breakthroughs and DOD can not finance all the state-of-the-art advances on its own.

Leverage allows DoD to take a portion of its research funds to find military uses for research conducted by commercial firms.

7. Surge Capabilities

A small defense-only base limits surge capabilities. Civil-military integration will make it easier to build back military capabilities to a higher level in emergencies. For example if a firm can make military and commercial items off the same production line and is profitable with one shift, then in a time of crisis a second or third shift may be added. If the firm is already at full capacity then production and delivery of military items could be expedited over the commercial counterparts.

D. CHAPTER SUMMARY

This chapter presented several advantages and disadvantages of civil-military integration of the defense industrial base. The disadvantages of pursuing a policy of CMI are: a history of failure, determining who benefits, product support, reliability, dependence on foreign sources, technology transfers to hostile states, training of acquisition personnel, quality assurance, potential for fraud, loss of technical data rights, and leverage. The benefits of CMI are: reduced costs (both administrative and direct), reduced time in the acquisition process, increased competition, technology transfer from the commercial sector, and leverage.

The following chapter addresses barriers preventing the integration of the commercial and military industrial bases.

V. BARRIERS TO CIVIL-MILITARY INTEGRATION

A. INTRODUCTION

This chapter focuses on the barriers to civil-military integration as well as possible incentives to commercial and defense firms to pursue integration.

Over the last several decades, standards, regulations, and specifications have been imposed on defense contractors that increased the segregation of the defense industry from traditional commercial firms. The purpose of these unique Government requirements was to promote socioeconomic equity and competition in the marketplace, account for taxpayer's funds, and ensure performance of items in a military environment. A concern on the part of the Government about the potential for fraud, waste, and abuse results in regulations above and beyond existing commercial codes and civil and criminal penalties for illegal actions.

In response to the regulations, defense contractors developed organizational structures and practices to enable them to conform to the Federal requirements. The cost of these structures is an allowable expense under Government contracts and is factored into the price of the final product. Firms that supply both the commercial and defense markets often have segregated defense and commercial units. [Ref. 56:p. x]

Pentagon contracting policies present a major obstacle for most defense firms trying to enter the civilian market as well as commercial firms trying to enter the defense market. The primary barriers to implementing dual-use policies are regulatory and bureaucratic, rather than technical. [Ref. 37:p. 240]

B. LITERATURE ADDRESSING BARRIERS TO CIVIL-MILITARY INTEGRATION

The barriers identified and discussed in this chapter are primarily drawn from three studies. Randall's thesis, "An Analysis of Reasons Commercial Entities Prefer Not to Participate in Defense Business" identified factors that discouraged participation in defense business by commercial firms. The Center for Strategic and International Studies has released two reports that address barriers to civil-military integration. The first, "Integrating Commercial and Military Technologies for National Strength" identified four major barriers to integration: accounting differences, specifications and standards, technical data rights, and unique contract requirements. [Ref. 56] 'Integrating Commercial and Military Technologies for National Strength" researched barriers for commercial firms trying to enter defense markets and defense firms trying to diversify to commercial work. A second CSIS study, "How U.S. Defense Industries View Diversification" conducted a survey to assess the degree to which acquisition regulations prevented diversification by defense firms into the commercial market. [Ref. 57]

Randall's thesis repeated research conducted by Lamm in 1987 studying the principal reasons for firms' refusal to participate in DoD business. Randall found that the primary reasons commercial firms elect not to participate in defense work, in order of frequency, were: burdensome paper work, Government bidding methods, more attractive commercial ventures, non-defense related product, low profitability, and inflexible procurement policies. [Ref. 58]

Despite efforts at acquisition reform over the past ten years through the Federal Acquisition Streamlining Act (FASA) and Federal Acquisition Reform Act (FARA), the reasons firms cited for not entering the defense business identified by Randall were similar to those identified in 1987.

> The top concerns for not participating in Defense business were the same for 1997 as they were for 1987. Burdensome paperwork, which was cited by 70% of the respondents in 1997, was cited by 69% of the 1987 respondents. Additionally, 67% of the respondent's reasons for becoming a defense contractor during the past ten years were not related to acquisition reform initiatives. [Ref. 58:p. 143]

In the Reddy study defense firms were asked the following question: "In general, do you believe that DOD contracting policies make it more difficult for the defense sectors of your company to enter or flourish in civilian market areas?" Table 5.1 reveals that seventy-one percent of the firms answered either "yes to a large degree" or "yes, to some degree. [Ref. 57:p. 24]

Table 5.1. Perceived Effect of DOD Contracting Policies on Defense Firms' Civilian Markets [Ref. 57:p. 25]

Type of Firm	To a large degree	To some degree	To a small Degree	No affect
All	49%	22%	10%	19%
Aerospace	50%	34%	8%	8%
Electronics	50%	25%	0%	25%
>50% DOD Sales	61%	28%	0%	11%
<50% DOD Sales	44%	24%	12%	20%

"DOD contracting policies make it more difficult for firms to enter or flourish in civilian markets." [Ref. 57:p. 25]

Once it was established that firms felt that DoD contracting policies may inhibit their ability to enter the civilian market, the study provided the respondents with a list of eight specific DoD contracting policies and asked them to rank them in the order in which they posed the greatest barrier. Table 5.2 summarizes the results.

Table 5.2. Rank Order of Factors Inhibiting Entry into Civilian Markets (Ranking by type of firms) [Ref. 57:p. 26]

Factor	All	Aero-Space	Elec-Tronics	>50% DOD Sales	<50% DOD Sales
Required use of parts and equipment built to military specifications	1	1	2	1	2
Separate accounting procedures for defense products	2	6	1	4	1
Specified manufacturing processes	3	2	6	2	5
Excessive auditing for defense contracts	4	7	3	5	3
Long-term instability of defense programs	5	3	5	6	4
Specified quality control techniques	6	4	4	3	6
Restricted use of civilian facilities	7	5	8	7	7
Overuse of suspension and debarment actions in defense contracts	8	8	7	8	8

The findings above indicate that the requirement to use MILSPECS rather than commercial processes, parts, or equipment is the policy posing the greatest barrier. Specified manufacturing processes and quality control techniques are addressed in MILSPECS and for the purpose of this paper will not be addressed separately. Separate accounting requirements was the second greatest barrier, followed by excessive auditing.

C. BARRIERS

1. Specifications and Standards

Defense firms view military specifications as the policy most inhibiting their ability to enter civilian market areas. The respondents were not required to answer why they thought each item was a particular barrier.

Although use of MILSPECS may cost more in the short run, over time they may save on life cycle costs because of increased logistics support and configuration management costs for components not in the military logistics system. However, the highly specialized nature of military equipment limits a defense firm's ability to transform its existing product to a civilian one especially if the MILSPEC differs from common commercial practices and standards. According to Gansler, military specifications create a barrier to commercial procurement when they:

1. Describe items which are essentially non-military in nature;
2. Require products or processes that are obsolete;
3. Detail process ("how to do it") rather than performance ("what is needed") requirements;
4. Are misapplied or inflexibly applied;
5. Are automatically imposed on subcontractors, even when they may be applicable only to the prime contractor; and
6. Differ unnecessarily from common practices and standards. [Ref. 59:p. 135]

Recognizing that a dual-use-manufacturing base cannot be achieved while DoD maintains a separate set of standards, MILSPECS were addressed by Congress under

FASA. As part of FASA and under the direction of the Secretary of Defense all heads of agencies were to ensure that to the maximum extent practical:

> (1) requirements of the agency with respect to a procurement of supplies and services are stated in terms of –
>
> (a) functions to be performed;
>
> (b) performance required; or
>
> (c) essential physical characteristics;
>
> (2) such requirements are defined so that commercial items or, to the extent that commercial items suitable to meet the agency's needs are not available, nondevelopmental items other than commercial items may be procured to fulfill such requirements...[Ref. 60]

2. Accounting Requirements

The second greatest barrier noted by Reddy was accounting requirements. Government Accounting Requirements can be divided into Cost Accounting Standards, Cost Principles, and Requirements for Cost or Pricing Data. Government contracts require the application of several accounting procedures and rules that are not used in the conduct of commercial business. Costs that might be legal under Internal Revenue Service regulations or Generally Accepted Accounting Procedures (GAAP) may be unallowable under Government contracts.

Accounting requirements are a result of Government efforts to ensure it pays "fair and reasonable" prices for the goods or services it procures. In the traditional free market, competitive market forces determine price and cost is irrelevant. However a Government contracting officer still has the option to request cost or pricing data. If the market lacks competitive forces there is some attempt to estimate what the market would

or ought to do through the imposition of reporting systems. These reporting systems attempt to provide information on the "true" cost of the product as well as on how the firm is managed, labor relations and other issues. [Ref. 39:p. 44] The accounting regulations serve to limit profit, and protect the Government against fraud. As programs become more complex and expensive the accounting regulations also served as tools to manage cost overruns and schedule slippage.

a. Cost Accounting Standards

Public Law 100-679 (41 U.S.C.422) requires certain contractors and subcontractors to comply with Cost Accounting Standards (CAS) and to disclose in writing and follow consistently their disclosed cost accounting practices. [Ref. 61:p. 166] Cost Accounting Standards have two goals. The first is to promote uniformity in accounting practices among Government contractors and the second is to obtain consistency in accounting treatment of costs by individual Government contractors. [Ref. 61:p. 166] FAR Part 30, Cost Accounting Standards Administration, promulgates procedures for applying the CAS such as accounting for the cost of money, depreciating capital assets, and allocating general overhead. CAS typically applies to prime and subcontracts over $500,000. The following types of contracts are exempt from CAS:

- Those where price is based on established catalog or market prices of commercial items sold in substantial quantities to the general public.
- Those where price is set by law or regulation.
- Contracts and subcontracts with Small Business concerns.
- Sealed bid contracts.

- Labor Surplus Area Set-Aside contracts.
- Contracts with foreign Governments. [Ref. 61:p. 167]

Some of the CAS procedures are different from the Generally Accepted Accounting Procedures (GAAP). An example is CAS 409- *Depreciation of Tangible Capital Assets* - which requires contractors to compute depreciation using procedures that may differ from tax or financial reporting procedures. [Ref. 56:p. 31]

CAS may prohibit prime contractors from partnering with leading commercial suppliers. For example, Pratt & Whitney makes aircraft engines for both commercial and defense customers. The engines require sophisticated electronic systems to operate, however companies such as Intel and Motorola "will not partner with Pratt & Whitney in custom technology development for the military because they will not abide by cost accounting standards and other unique defense requirements." [Ref. 28:p. 10]

b. Cost Principles

The cost principles are addressed in FAR Part 31, Contract Cost Principles and Procedures. These principles outline what charges against a Government contract are allowable. They apply to contract pricing "where cost analysis is performed and/or where the determination, negotiation, or allowance of costs when required by a contract clause." [Ref. 62] A senior officer in the company must certify that all costs reported under a Government contract are allowable in accordance with FAR Part 31.

To protect itself, a company will not only have to track its own costs but also that of its suppliers. "The problem is not that the information cannot be obtained.

Rather, the problem is that a growing number of commercial companies are unwilling to invest the money and effort for what amounts to a relatively small erratic and lower-profit portion of their business." [Ref. 56:p. 32] Companies may fear that without detailed documentation of costs under a well-established Government cost accounting system they risk criminal sanctions.

c. Requirements for Cost or Pricing Data

In 1962, Congress passed the Truth in Negotiations Act (TINA). The purpose of the Act was to put the Government on equal footing with contractors in contract negotiations. Prior to award of a negotiated contract, a contractor may by required by the Truth in Negotiations Act to certify as current, accurate and complete, cost or pricing data. Further, the contractor is subject to penalties if the data are found defective. Contracts that are awarded under adequate price competition, under $500,000, for items whose price is set by law or regulation, or for commercial products are exempted. However, contracting officers may require certification of cost or pricing data even if not required by law. In FY 1997, about 53,000 contractual actions, valued at about $46.3 billion, were subjected to the Truth in Negotiations Act. [Ref. 49] This represents approximately 37 percent of procurement outlays of $126.8 billion for the DoD in 1997 and twenty percent of the contract actions over $25,000. [Ref. 63]

The data provided by the contractors must be accumulated in accordance with CAS rules and the cost of collecting the information is not reimbursable. [Ref. 56:p. 34] As the costs for TINA compliance start occurring during the solicitation phase before a company enters a contract with the Government, it serves as a barrier preventing

commercial firms considering defense work. A Coopers & Lybrand study found that TINA requirements were the second highest cost driver of all Government regulations behind MILSPEC compliance. [Ref. 64:p. 18a]

Proponents of the Act claim that the Act encourages most sole-source contractors to be open and fair and the benefits of the Act outweigh the costs. [Ref. 49:p. 29] The assumption here is that contractors would raise prices to exorbitant levels if not legally required to disclose true costs. However contractors know Government funds are limited and realize, as all sellers do, that if a price is too high the customer will decline to purchase the item. If the Government feels that the pricing risk is sufficiently high, it can require data on a particular contract or portion of a contract.

It should be noted that in Reddy's study categories of barriers were provided to respondents. Alic, Bingaman, and Gansler have identified additional barriers: technical data rights, unique contract requirements, budget process, commercially uneconomical orders.

3. Technical Data Rights

In an effort to increase competition and reduce reliance on sole-source procurement the Government may seek the right to "use, duplicate, or disclose to others technical information concerning products it purchases, particularly in cases where the Government has funded the product's development." [Ref. 31:p. 149] The Government may use the rights to find sources other than the developer to manufacture, repair, or maintain the component developed.

A concern of industry is that the technology developed for the Government may include background technology developed at the contractor's expense. As a result a company may segregate DoD development projects from internally funded commercial efforts or refuse to take on DoD work altogether.

Under current law and DoD regulations technical data rights fall under three categories: unlimited rights, Government Purpose License Rights (GPLR), and limited rights. Unlimited rights are obtained when the Government fully funds the development or specifies unlimited rights in a contract, or if the development was accomplished during and was necessary for the performance of the contract. [Ref. 56:p. 59] GPLR provide for unlimited usage by the Government including transfer of the rights to a third party to use in a Government contract, but prevent the Government from letting third parties use the data for non-Government purposes. GPLR are obtained when there is mixed funding for the development or when commercial utilization of the technology is desired. Limited rights prohibit the Government from disclosing the data without approval of the contractor and prevent its use for competitive reprocurement.

Technical data rights serve as a barrier to commercial military integration because firms that make a military modification to a state-of-the-art commercial process may face a situation in which the Government wants unlimited rights. Under GPLR there is a fear that once the Government provides a second source with the data rights a competitor may use the information for its commercial business despite the nondisclosure provisions. Lastly, bidders offering limited rights may be penalized in a "best value" competitive

solicitation if the Government feels that limited rights may result in higher life cycle costs.

4. Unique Contract Requirements

The Government seeks many goals in addition to accountability for taxpayers' funds. Federal contracts also contain provisions to promote socioeconomic goals, control sources of supply, and control relations with suppliers. The myriad of required clauses resulting from legislative and regulatory controls may be applied differently among contract offices. For example, the GAO found that in order for a supplier to sell an identical commercial oscilloscope to the Army, Navy, and Air Force a supplier had to deal with 205 different contract clauses of which only 12 percent overlapped among the three contracts. [Ref. 59:p. 138] Table 5.3 provides a non-exhaustive selection of contract requirements placed in defense contractors.

a. Source Restrictions

The U.S. Government has historically put a preference on the purchase of domestic materials in order to protect a domestic industry. For example, the Buy American Act favors domestic sources by requiring a cost differential be added to foreign products. A bid from a foreign source will have a certain percentage (determined by law) added to it. If the award is solely based on price and the foreign bid is still lower with the differential, it will receive the award. If the differential causes the price to exceed the domestic bid, the domestic source will receive the award. Other contract clauses require a manufacturer to certify that the item meets a level of domestic content. However many firms now produce components offshore or use offshore suppliers that are more efficient than

Table 5.3 Contract Requirements Placed on Defense Contractors

Objective Category	Program
Labor	Service Contract Act Davis Bacon Act Labor Surplus Area Subcontracting. Program; 15 USC 644 (d)-(f) Utilization of Labor Surplus Area Concerns; 15 USC 644 (d)-(f)
Discrimination and affirmative Action	Affirmative Action Compliance; E.O. 11246 Equal Opportunity Compliance; E.O. 11246 Cert. Of Non-Segregated Facilities; E.O. 11246 Affirmative Action for Handicapped Workers; 29 USC 793
Business Set Asides	Utilization of Women-Owned Small Business; E.O. 12138 Small Business and Small Disadvantaged Business Subcontracting Plan; 15 USC 637(d) 4-6
Foreign Acquisitions & Source Restrictions	Buy American Act Balance of Payments Program Certificates; Buy American Act and Balance of Payments Program; 42 USC 10a-d, 10b-1. Foreign Source Restrictions; DFARS 253.225-7025 Required Sources for Jewel Bearings and Related Items; PL 90-496
Relations with Suppliers	Foreign Corrupt Practices Act False Claims Act (Civil) 31 USC 3729 False Claims Act (Criminal) 10 USC 287 Anti-Kickback Act 41 USC 51-58 Truth in Negotiations Act 10 USC 2306 (f) Procurement Integrity Act 41 USC 423
Drug-Free Workplace	Drug-Free Workplace; 41 USC 701

Source: Developed by researcher.

protected domestic sources. The result is a disincentive to accept defense work. Companies would have to dual source suppliers and segregate costs of their commercial work from their defense production in order to remain competitive in the commercial market.

FASA did not address source restriction at the prime contract level. However, implementation of FASA into the FAR precluded "flowing this restriction down" to subcontractors providing commercial items or commercial components.

Even if regulations are identified as barriers to integration, there will always be supporters justifying their necessity. Two additional regulations slated for repeal or elimination through the proposed Defense Reform Act of 1998 are elimination of fee limitations and changes to the False Claims Act. [Ref. 49:p. 25]

b. False Claims Act

A contractor faces heavy fines and administrative penalties for fraudulent conduct. A person who "knowingly" submits a false or fraudulent claim for reimbursement is liable under the Act. A person acts knowingly if he has actual knowledge of the information or acts in deliberate ignorance of the truth or falsity of the information. [Ref. 65] The Government is not required to find proof of specific intent to defraud the Government.

The False Claims Act has been cited as a reason that commercial contractors will not do business with the Government. Commercial contractors fear that if they make a mistake they will be charged with fraud. [Ref. 49:p. 26] Under the False Claims Act a contractor is subjected to penalties and treble damages for submitting erroneous documentation.

According to Eleanor Hill, Inspector General, Department of Defense,

> A simple mistake does not amount to a false claim subject to the False Claims Act. The Act requires a knowing submission of a false or fraudulent claim; the knowing use of a false record or statement to get a

false or fraudulent claim paid; or a conspiracy to defraud the Government by knowingly getting a false or fraudulent claim paid. [Ref. 49:p. 27]

However, it is difficult to prove deliberate ignorance or reckless disregard of the truth. As a result courts have found it sufficient for criminal convictions if evidence is presented beyond a reasonable doubt of the falsity of the statement. [Ref. 49:p. 27]

If evidence does not exist beyond a reasonable doubt then the False Claims Act allows for civil penalties when knowledge of a falsity is proven by a preponderance of the evidence. If the Government cannot win in a criminal trial it may pursue a civil case. Despite Ms. Hill's assurances, the power given to the Government under the Act is hardly attractive to businesses contemplating bidding on Government contracts.

The qui tam provisions of the civil False Claims Act allow private individuals to initiate lawsuits on behalf of themselves and the Government and then keep a share of the Government's recovery. [Ref. 66] Qui Tam is the legal term for "Who sues on behalf of the King as well as himself." Under U.S. law the plaintiff states that he sues for the state as well as himself.

During the Persian Gulf War the Air Force placed an emergency order for 6,000 commercial two-way radios manufactured by Motorola. The Pentagon waived all MILSPECS. However, DoD was unable to get Motorola to certify that the Government was getting the lowest price for the product. Motorola executives cited that the radios were marketed through a variety of channels with varying prices. Motorola also did not

have a Government-approved cost accounting system required for the certification. Any misstatement by Motorola regarding the cost of the radios could have resulted in a felony conviction. Therefore, no senior official would certify the price of the radios. To solve the dilemma, the Government of Japan bought the radios and donated them to the Air Force as part of their contribution to the allied war effort. [Ref. 28:p. 9] The reforms initiated by FASA would allow DoD to purchase these units now, however the False Claims Act still makes headlines in awards against defense contractors.

In April 1998, a Federal Jury imposed a $310 million fine against FMC Corporation, the manufacturer of the Bradley Fighting Vehicle. An FMC employee discovered that the Bradley, which was supposed to float across rivers and lakes, tended to leak when crossing a body of water. FMC delivered the Bradley claiming that it floated. The employee's main accusation, under the False Claims Act, was that it did leak and could therefore sink when crossing a river. Using the qui tam provision, the employee and his lawyers received $77 million with the remainder going to the U.S. Treasury. [Ref. 66]

c. Fee Limitations

The Department of Defense Reform Act of 1998 proposes a repeal of the fee limits on cost-plus-fixed-fee (CPFF) contracts for experimental, developmental, or research work. Currently, the fee limitation is 15 percent for research and development contracts, six percent for architectural or engineering (A&E) services, and ten percent for any other CPFF contracts. Proponents of the fee limitation claim that there is adequate competition with the limits in place and that they prevent overspending on design to the

detriment of manufacture or construction. According to the Department of Defense Inspector General, 84 percent of A&E contract awards had multiple bidders. [Ref. 49] However, if there are multiple bidders for these contracts, shouldn't competition, not a statute set the profit level? Why does the Government need a profit ceiling on the 84% of contracts that are awarded competitively?

Profit as a barrier to attracting commercial firms to defense business was also documented by Randall who found that changes in acquisition laws (reforms) over the previous 10 years were not sufficient for firms to see DoD work as a profitable venture. [Ref. 58:p. 136]

5. Budget Process

The U.S. Government operates under a single-year defense budget process. In contrast, commercial firms make multiyear procurement commitments to plan production, forecast labor needs, and procure materials in advance to take advantage of volume discounts. [Ref. 59:p. 140] Multiyear procurement commitments are the exception for DoD requirements. Multiyear procurement would enable the DoD to provide stability to suppliers and enable them to develop long term forecasts.

6. Commercially Uneconomical Orders

With defense budgets and the resultant purchase of goods and services varying from year to year, some firms are unwilling to make the investments needed to maintain facilities or skilled personnel for military equipment. [Ref. 25:p. 46] The reduction in the number of goods purchased often results in a lower number of producers and, in many cases, multiple producers of an item will not exist. The end result from reduced

competition is that the Government will be required to impose cost accounting and oversight on the remaining contractor and further discourage CMI.

7. Cultural Barrier

The current acquisition culture tends to emphasize that personnel know more about how to apply the regulations than about the actual products they buy. [Ref. 25:p. 77] The skills and background of acquisition personnel may serve as an obstacle to acceptance of using commercial items or practices. The fact that acquisition reform has not increased commercial firms' willingness to take on defense work may be a result of reforms not being implemented by contracting personnel as well as a failure of DoD to communicate the reforms to commercial manufacturers. [Ref. 58:p. 136] Media sensationalism of any procurement mistake further encourages acquisition personnel to stay with tried and true standards and processes rather than looking for commercial practices or products.

There is a cultural difference in the approach to innovation between the commercial and military sectors. There are several instances where innovation is similar such as for large capital equipment or regulated industries. However "[the] opportunities for synergy are limited." [Ref. 31:p. 44] Table 5.4 identifies differences in the civil and military cultures with regard to innovation. Any policy promoting innovation through civil military integration will have to address these differences.

D. FEDERAL GOVERNMENT INCENTIVES

Defense contractors were also given a list of incentives for moving into civilian production and asked to rank them. The survey asked "If the federal Government were to offer incentives for moving into civilian production, which would be most attractive?"

Table 5.4. Two Cultures - Civil and Military Innovation [Ref. 31:p. 44]

	Civil	Military
Impetus for Design	Market Driven, opportunistic introduction of new products	Dictated by military requirements
Nature of response	Rapid, incremental improvements, punctuated by more fundamental redesigns	"Big leap" improvements
Product Cycle	Measured in years	Measured in decades
Priorities	Process Technology for low cost manufacturing, high quality, and flexibility	Product technology for functional performance and long shelf life
Production	High rates and volumes (in consumer product industries)	Low production rates and unit volumes
Linkage of R&D and production	Integrated management of R&D, production, and customer service	R&D and production separately contracted and sequential
Technology sharing	Success based on proprietary technological advantage	Success may require sharing know-how with second source contractor

Given a list of five incentives, respondents ranked them as follows (from the most attractive to the least):

1. Government reimbursement for self-initiated R&D costs in civilian fields in the framework of DoD contracts with departments of Government other than the Pentagon (e.g., Transportation, Energy, Health, Education, Justice).

2. Easing of DoD contracting policies.

3. Increase in DoD R&D ceilings.

4. Tax incentives for "dual-use" applications.

5. Adoption of "dual-use" as a broad national policy, but with no other Government action. [Ref. 57:p. 28]

The first choice for incentives for entering the civilian market was for defense contractors to increase their business with civilian Government agencies, followed by an easing of DoD contracting policies.

Randall found that companies wanted the following improvements in acquisition procedures to enter defense business:

1. Reduce the use of military specifications;

2. Eliminate non-relevant paperwork in bidding requirements;

3. Ensure timely payments to contractors;

4. Reduce the amount of paperwork in the overall procurement process.

A difference between incentives for defense firms to broaden into commercial work and commercial firms to enter into the defense business is that defense firms prefer to broaden into commercial work with Government assistance. They prefer to expand into contracts with other Government agencies and seek subsidies for R&D or tax incentives. This may be an indication that they want to stay connected to the Government as a customer or rely on the Government to subsidize any dual-use projects.

The common feature between the Reddy and Randall findings is the incentive of easing DoD contracting policies such as military specifications.

E. SUMMARY

The barriers to civil-military integration identified by both commercial and defense firms are all regulatory in nature. They can be summarized as accounting requirements, military specifications, technical data rights, and unique contract requirements. Contractors have little control over removing the barriers, as they are Government imposed. The barriers contribute to a cultural perception that there is "too much paperwork" for entering the defense business by commercial firms and that Government assistance is needed for defense firms to diversify into the commercial sector.

Chapter VI provides an analysis of the data collected in the previous chapters.

VI. ANALYSIS

A. INTRODUCTION

The previous chapters discussed several issues: the consolidation of the defense industrial base resulting from the reduction in defense spending; the differences between traditional defense markets and the weapons market; the policy of expanding the defense industrial base through civil-military integration (CMI); the benefits and costs of carrying out CMI; and the barriers to implementing CMI. This chapter analyzes the information collected, and presented in the previous chapters.

B. THE IMPORTANCE OF A STRONG DIB

1. Independence from Foreign Suppliers

Foreign sources of supply may provide products unsuitable to a Government's needs and dependence on such products may result in monopoly prices. However, dependency on foreign sources should not be confused with vulnerability. If a purchasing Government has several foreign sources to choose from, it can conduct risk analysis on the possible interruption of supply similar to that conducted on domestic suppliers. As long as the dependency is not concentrated in one country or geographic area, foreign supply may be as safe as a domestic source with significant market power. Policy makers must know the difference between dependency and vulnerability when placing source restrictions on components.

The DoD's use of a foreign supplier may prevent monopoly behavior from a sole-source domestic producer or, in the case of the United States, recently consolidated domestic suppliers. Civil-military integration could create a greater dependency on or vulnerability to foreign suppliers.

Commercial firms operating in a global marketplace may elect not to accept defense business when faced with source restrictions. Before imposing source restrictions that serve as a barrier to attracting commercial firms, the Government should determine its vulnerability to an interruption in supply.

2. Unsuitable Equipment

Another benefit of a strong defense industrial base is that it is easier to tailor weapon systems to the producing nation's needs. When nations with no industrial base purchase weapons from supplier nations, however, options on the weapons platform are negotiable. Some tailoring or customization can take place. The latest block upgrade may not be available for security reasons; however, an older variant may be. This older variant may be adequate to address the threat from the buying Government's potential adversary.

A supplier also benefits from providing weapons platforms similar to those it uses. The indirect costs of production can be spread over many weapons and repair parts, reducing the overall cost of the system. Interoperability during military exercises is also enhanced since both countries will have similar training and can use interchangeable parts. Governments without an industrial base know these advantages and will negotiate accordingly for the latest available technology.

3. Leverage

Leverage was also cited as a benefit of a strong defense industrial base, yet purchasing Governments could apply leverage as well. Countries without a DIB can threaten to go to rival suppliers to reduce prices or negotiate upgrades. They can then use this leverage to encourage suppliers to provide weapons with the latest technology or tailored systems to meet the purchasing countries' needs.

4. National Economic Benefits

The national economic benefits of a defense industrial base may also be overstated. First, despite the reductions in procurement spending, there are now more defense employees than there were twenty years ago. Although cuts in the procurement budget may lead to an initial decrease of employment, the evidence suggests that defense workers transition into other fields. Employment levels may be tied more to the overall health of the national economy than to Government spending.

5. Self-Sufficiency & Production Capabilities

Although a strong DIB provides self-sufficiency, it also has its costs. The exclusion of foreign sources in order to promote self-sufficiency may result in monopoly prices from the domestic supplier. In addition, the buyer may not obtain the efficiencies and innovation associated with a competitive marketplace. There is no empirical evidence for measuring the exact cost of maintaining self-sufficiency for various weapon systems. However, the U.S. Government, in the case of submarines, believed that the benefits exceeded the costs. The desires to be ready to respond to an emergency and to

maintain unique capabilities led the U.S. Government to purchase a weapon (the Seawolf) that might not have been immediately necessary.

It may be that submarine manufacturing continues despite a lack of need because the technologies and manufacturing processes are uniquely military. It would be difficult to count on commercial technologies or processes to maintain the skills or handle any future surge requirement.

Civil-military integration may contribute to maintaining production capabilities through the use of flexible manufacturing processes. Companies such as TRW, which can produce military and commercial items on the same assembly line, could increase production rapidly to meet any surge requirements. A potential production capability serves as a deterrent to hostile Governments and, therefore, provides security benefits.

Of the advantages discussed above, leverage and unsuitable equipment can be addressed at the negotiating table and do not appear to provide major advantages over countries without a defense industrial base. The advantage of independence from foreign sources may be diluted through CMI. As the economy becomes increasingly global, commercial suppliers without source restrictions look for the best value worldwide. There is also evidence, levels of employment in particular, to refute the idea that the defense industrial base provides national economic benefits that could not be obtained through private-sector spending. The benefits of self-sufficiency are costly, but the U.S. Government's decision to maintain self-sufficiency in submarine production may show that the security benefits are sometimes perceived to outweigh the costs.

C. THE FREE MARKET VS. THE WEAPONS MARKET

Many free market practices are now similar to defense market practices. For manufacturers of large capital equipment, there are few sellers in both markets. Through the use of cost as an independent variable (CAIV), procurement officials may trade performance for price as a buyer in the commercial market would.

Unlike the commercial market, the Government serves as buyer, regulator, and judge of claims in the defense market. The Government establishes the barriers, whether real or perceived, to entering and exiting the defense market. The differences between commercial and Government contracts are essentially in contract type, length, and objective.

The Government will use cost-plus contracts for research and development, whereas commercial contracts are almost exclusively fixed-price. Both traditional and weapons contracts may change over the course of the contract. A commercial contract may have a fixed scope and price because it must be completed more quickly than a weapons contract. And Government contracts for major acquisitions may also be, on average, longer than their commercial counterparts. Government contracts may take several years to go from concept exploration through research and development.

One of the goals of acquisition reform is to eliminate oversight and, instead, have insight (i.e., understanding of) a contractor's processes. With this new emphasis on decreasing involvement in the steps of the process, the Government maintains an "arm's length" relationship and, in some cases, establishes "teaming" arrangements. As a result,

the relationship between buyer and seller is not as differentiated as it was prior to acquisition reform.

The difference in dispute resolution between commercial and Government contracts also has narrowed. Disputes in traditional contracts are not always litigated because commercial firms are sensitive to the costs of litigation and may handle differences informally or through alternative dispute resolution.

The differing objectives of traditional and Government contracts result in a barrier to CMI. The purpose of commercial contracts is to obtain goods and services, whereas Government contracts often to promote socioeconomic goals in addition to obtaining the desired goods and services.

D. STRATEGIES FOR ACHIEVING CMI

This researcher found three options for expanding the defense industrial base through civil-military integration: defense conversion, diversification, and dual-use technology. Defense conversion proved to be the riskiest policy since defense companies tended to rely on Government investment and programs to pursue this strategy. Most attempts at conversion were geared toward a policy the Government was trying to promote at the time, rather than toward conversion to a familiar technology. The examples that were cited by this researcher--Government-supported programs such as alternative energy sources and mass transit--resulted in failure. The drawback to conversion is that if the "crisis" goes away, so will Government funding. As energy prices dropped after the seventies and early eighties, the years when the conversion

programs existed, the need for mass transit and alternative energy sources also disappeared. Had the defense firms pursued a market similar to their core technology, as Raytheon did with microwave technology, the results may have been different.

The second option, diversification, was a strategy to reduce reliance on defense business. The mergers and acquisitions over the past decade were more of a consolidation of defense industries with the defense divisions of diversified firms. Loral acquired or merged with IBM Federal Systems, Ford Aerospace and Goodyear Aerospace. Northrop Grumman and Raytheon acquired Westinghouse's and Texas Instrument's Defense Divisions, respectively. The Department of Defense is not currently encouraging or pursuing the strategy of diversification to integrate the defense industrial base. In fact, until 1998, the DoD encouraged consolidation.

The key to achieving CMI may be through the third option, designing for dual-use. This program enables the DoD to incorporate, from the outset, commercial rather than unique military technologies. An important factor for success is the environment in which the product will have to operate. A successful example of dual-use were satellites in which the commercial item would operate in essentially the same environment as the military one. Just having many similar components in the defense and commercial systems is not enough. Recognizing the ultimate environment in which the system will have to operate may be as important as integrating the production line through similar processes and standard parts to reduce costs.

Dual-use is not without deficiencies. For example, military agencies guiding the dual-use program will push innovation and technological development in directions that

are not economically optimal for commercial or military use. To realize the benefits of dual-use, agencies may develop a sub-optimal solution for both commercial and military uses. The benefits of "spin-offs" from dual-use may not be sufficient to offset the sub-optimal military research and development used to obtain the benefits.

Continued support and maintainability will also be a key issue. The F-22, which uses dual-use technologies for many of its avionics, cannot be built as designed due to the pullout of a commercial supplier and the lack of a substitute. This negates any time saving gained from the insertion of the commercial technology into the platform.

The Commercial Operations and Support Savings Initiative (COSSI) enabled the Government to use Other Transactions Authority to attract non-traditional firms to the defense market. The program is expected to save money over the long run through use of commercial technologies; however, no agreements have reached the production stage, in which standard procurement regulations will apply. COSSI's ability to attract commercial firms to defense work may also be questioned. Traditional defense contractors accounted for 80 percent of the participants in "other transactions." The program did, therefore, attract new suppliers; however, it should not be considered a complete success because program offices were given freedom from Government regulations. When the production stage is reached and standard procurement clauses apply, some of the participants may choose not to participate.

COSSI also faced erratic budgeting. Except for the continuation of existing agreements, Congress cut funding for COSSI in FY 1998. Personnel at the program office thought this was due to DoD's inability to convince Congress of the initiative's

importance. The 1999 budget contained funds for COSSI, but this highlights a weakness of initiatives: they are subject to changes in perceptions of their need.

E. ADVANTAGES AND DISADVANTAGES OF CMI

1. Advantages

The primary advantage of CMI is the expansion of the industrial base to meet surge capacity, increased competition, and leverage in research funding. If CMI is successful, the DoD will be able to draw upon significantly more contractors and industrial capacity to produce required items for an emergency. The U.S. military could use this potential power to gradually augment existing forces, an important factor in the military's desire to be able to support two major regional conflicts simultaneously.

An increased number of contractors available to produce items for the military should result in greater competition. This competition should result in innovation and lower prices. Furthermore, adequate price competition would eliminate the need for several regulations that currently impede CMI.

Leverage is another cited advantage of CMI. Costs for developing new technologies will be shared with the commercial applications, resulting in overall lower investments required. The capabilities, however, may not be as great as if funding and research were targeted for military use only.

2. Disadvantages

This researcher identified several disadvantages to CMI, such as determining who will benefit from any policy established, transfer of technology, loss of standardization,

reduced reliability, and integration of commercial components. When a program is initiated to advance a policy, it will be difficult to determine who will benefit from it. For example, the Government would have to determine which previously protected domestic sources must compete on the world market. Established defense firms may also resent the fact that regulations they fall under are waived for newcomers to the defense market. However, as few firms have taken advantage of the initiatives waiving the requirements such as "other transactions authority," this is not a great issue.

Segregation of commercial and military technologies helped prevent transfer of sensitive technologies to hostile nations. In the case of missile technology, Loral successfully lobbied the administration for permission to transfer technology used in its commercial systems to the Chinese Government. The administration then designated the technology to be under the jurisdiction of the Commerce Department rather than the Department of State. The results were a transfer of technology that the Chinese Government converted to military use. This issue has serious security implications and will likely result in additional monitoring by Congress. As a result, firms may fear that any technologies they develop with the DoD could be restricted when they try to export them as commercial products.

Another disadvantage of CMI is the possible loss of standardization. Commercial firms market their products as unique and not as commodities. Commercial components may meet performance specifications and fall under a broad standard; however, they may not be interchangeable. The design of a weapons platform and the integration of

commercial components pose additional risks through the loss of standardization that was present with a military specification.

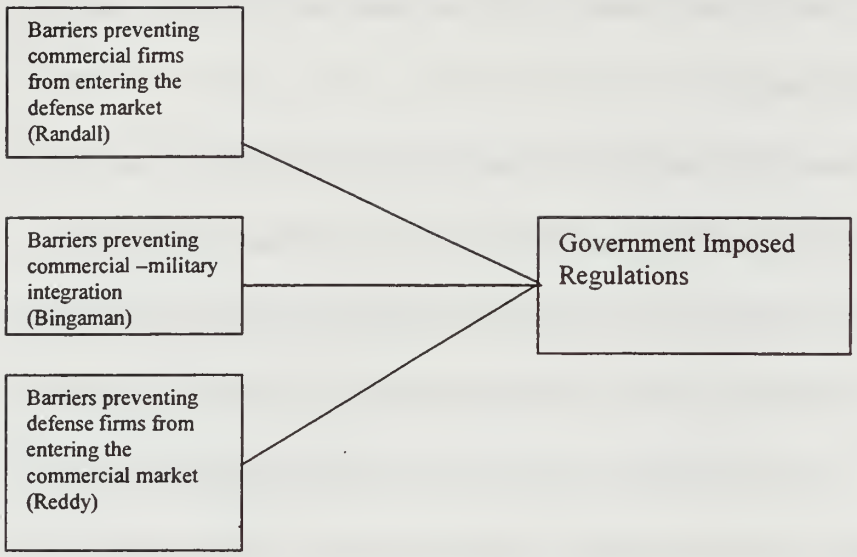
The reliability of commercial products also must be addressed. When commercial and military systems are designed to operate in the same environment, such as space, reliability is a minor issue. However, if a component is designed to work in an office environment, yet may also have to operate in the Arctic Circle or the desert, reliability becomes a major issue. With the limited space inside a weapons platform such as a tactical fighter, radiation and electromagnetic hardening also become important. Performance specifications must address these environments, and the result may be components as unique as a MILSPEC item.

Integration of the components will also be difficult. Dual-use technology can reduce the overall cost of the technology in items such as night vision devices and GPS units. However, in these often-cited technologies, the units were used as stand-alone devices. If they are integrated into a complete system such as an avionics package, the cost savings may not be as dramatic.

F. BARRIERS TO IMPLEMENTING THE POLICY

The three studies addressing barriers to integrating the commercial and industrial bases have a common theme: Government regulations. Figure 6.1 depicts this common link.

MILSPECS were found to be one of the major barriers preventing civil-military integration, despite acquisition policies requiring the use of performance or commercial



Source: Developed by researcher.

Figure 6.1. Common Link Among Studies Addressing Barriers to Civil-Military Integration

specifications or standards unless they were inadequate. Civilian contractors may not be aware of the reforms, or the acquisition workforce may not be implementing them. MILSPECS were found to perform a necessary function of standardization and to prevent integration problems noted in this research.

Accounting requirements, such as cost accounting standards, were also found to hinder CMI of the DIB. However, even within the DoD, there are personnel who believe that the regulations protect the Government and save money by preventing fraud. An alternative may be to study which Generally Accepted Accounting Practices (GAAP) can be used to gain insight into a contractor's costs. If the Government were to use a contractor's existing records, which are suitable for financial and tax reporting, then the

barrier could be removed. However, commercial accounting practices will not provide the detailed cost information that can be obtained through cost accounting standards.

Another barriers is created by the unique contract requirements placed on contractors for socioeconomic goals, source restrictions, fee limitations, criminal penalties, and relations with suppliers. These regulations inflate the cost of any procurement by adding requirements unrelated to the purpose of the weapons system. They also restrict a contractor's ability to select the suppliers who provide the best value. Instead, they require a contractor to select sources whom the Government determines needs assistance. With rapid technological changes and a global economy, these requirements may make any agreement unattractive to many non-defense firms.

A cultural barrier also restricts integration. Defense firms attempting conversion tried, for the most part, to convert to Government-subsidized industries. In the Reddy study, when defense firms were asked what was needed to diversify to the civilian marketplace, the number one answer was Government reimbursement for civilian R&D with other Government departments. This indicates that many firms in the defense industry prefer working with the Government rather than moving into a competitive commercial marketplace. The reasons commercial firms refuse to enter the defense market have not changed since the Federal Acquisition Streamlining Act. This evidence may indicate that procurement personnel are not fully implementing acquisition reform.

G. SUMMARY

Before the DoD can implement CMI, it must remove the impediments to making it happen. The defense and commercial markets are not as different as they were when Gansler described the differences in his 1989 book, *Affording Defense*. The remaining differences in the markets are Government-imposed barriers that can be unilaterally reduced or eliminated. To truly promote a policy of CMI, the DoD should adopt commercial practices and standards. But its ultimate goal should be to use one set of regulations governing all businesses engaged in interstate commerce. It is crucial to remove impediments to CMI in addition to funding initiatives to hold up as examples. The initiatives developed to date have been small, and their overall effect on achieving CMI of the industrial base is questionable. Additionally, they have relied on annual funding, which can be erratic. If success is proving that dual-use technologies can be accomplished, then there are examples to offer. However, if treated as a mathematical or scientific hypothesis, where only one example needs to be held up to disprove it, then it is currently a failure. Before moving forward with a broad policy initiative to expand the industrial base through CMI, the DoD must identify and then remove or isolate the causes of the failure.

VII. CONCLUSIONS AND RECOMMENDATIONS

A. INTRODUCTION

The objective of this thesis was to study the policy option of civil-military integration as a means of expanding the industrial base. To explore this subject, the researcher reviewed the recent history of budget reductions and resulting mergers and acquisitions in the defense market. The researcher also analyzed the characteristics of the defense and traditional commercial markets, the advantages and disadvantages of civil-military integration, and the barriers to implementation of the policy. This chapter presents the conclusions of this thesis, offers recommendations, answers the primary and subsidiary research questions, and suggests areas for further research.

B. CONCLUSIONS

1. Of the three methods found to expand the Defense Industrial Base through civil-military integration, dual-use technology is currently the most promising.

Previous attempts to integrate and diversify the industrial base through defense conversion resulted in failures. The industry has transitioned from one made up of many diversified defense contractors in too many declining segments to one comprised of a few highly-focused companies. The remaining option is dual-use research and development to exploit advanced commercial technologies, integrate commercial production facilities, and insert commercial technologies in existing platforms.

2. CMI can provide necessary cost savings in an era of reduced budgets.

Provided that there is no significant change in the threat to national security, the defense budget is expected to remain the same in real dollars for the foreseeable future.

The cost of maintaining a separate defense base has become prohibitive and has resulted in the mergers and consolidation of several defense contractors. Use of commercial standards and practices can save procurement dollars. By promoting competition, transferring civilian technology to defense use, and using leverage, the COSSI program alone is expected to save three billion dollars over the next ten years.

3. The risks associated with CMI are the lack of reliability, logistic support and compatibility.

As Chapter IV indicated, some personnel associated with the defense industry are concerned about their ability to operate, support, and maintain non-MILSPEC items in military environments. The needs for logistic support for these items and for the ability to maintain systems incorporating them also add risk. Procuring offices must address design practices for electronic components to reduce the risks associated with commercial or non-developmental items. As technologies move rapidly in the commercial sector, these risks must be mitigated by focusing on system architectures that allow continual upgrade. This will reduce the likelihood of having to force a manufacturer to make obsolete parts or warehouse repair parts. Standards followed by commercial designers may be incompatible with each other. The uncertainty over compatibility can inhibit a program manager's willingness to depart from MILSPEC items. MILSPEC reform must be implemented carefully, and commercial items must be judged according to their ability to perform in a military environment.

4. Civil-military integration should be concentrated at the early stages of a weapons acquisition program.

Civil-military integration is best achieved at the earliest stages of a weapons program. By starting with research and development, contracting offices can obtain the

superior technologies available in the commercial sector and design them into a platform. At the early phases of a weapons program, designers can establish the capabilities and limitations of commercial items and determine whether they are acceptable. If they are found acceptable, then the design must allow for the replacement and upgrade of the components. The earlier a risk can be identified and compatibility problems worked out, the sooner the various systems can be integrated. When dual-use technologies are incorporated into the design, suppliers can use flexible manufacturing processes. As the system moves closer to the production stage, opportunities to integrate commercial technologies diminish due to higher integration costs and risks.

5. The greatest barriers to civil-military integration are regulatory.

Regulations imposed on Government contractors are the greatest barrier to civil-military integration. For both defense contractors attempting to diversify to the commercial market and commercial firms trying to enter the defense market, the common impediments were: accounting requirements, military specifications, and unique Government contract clauses. Some of these barriers may be necessary, as in the case of military specifications, while others promote social goals that have little to do with maintaining a strong industrial base. If the Government wishes to reap the rewards of the commercial sector, then it must also accept the risks of working in the commercial environment.

C. RECOMMENDATIONS

1. Eliminate or drastically reduce unique Government regulations.

If the major barriers between the commercial and defense markets are eliminated, civil-military integration is more likely to occur. Acquisition reforms, to date, have not

been successful in attracting firms to defense business. The DoD should target the regulations that are the primary impediments to integration. Transition to dual-use technologies is best accomplished early in the design stage and at the lower tiers, rather than at the prime or integrator level, where design changes are risky. By eliminating the "flowdown" requirements, prime contractors can partner with leading technological firms to obtain state-of-the-art technology and increase the surge capacity of the DIB. As more non-defense firms enter into partnerships, competition will increase, and the need for many of the "flowdown" clauses should be eliminated.

2. Review current initiatives underway in promoting civil-military integration.

DoD should study current dual-use initiatives to determine various causes of failures and successes. DoD should then determine whether or not the failures can be corrected or if they should be left strictly to defense contractors to correct. Finally, DoD should build on the successes by looking for similar contracts or systems that may benefit.

3. Expand acquisition reform to include a "commercial facility" designation.

If an item is built in a factory alongside commercial items, and the defense portion of the company is very small, then the Government should eliminate its unique requirements. If the defense portion of a firm's business is below a designated limit, it would then be exempt from unique Government regulations. A contractor would then have an incentive to increase its commercial sales to reduce the relative percent of defense business. The Government would benefit from greater surge capacity, and the efficiencies of running the commercial factory would spread to the defense items. Cost

analysis using the contractor's existing accounting practices would verify whether the price of the defense items was reasonable in relation to that of the commercial ones. There are two concerns with this recommendation. First, contractors at the cusp of the designated level may elect not to compete for additional Government contracts. Second, verification of the level of Government and commercial work must be verifiable without establishing additional requirements or agencies to monitor the contractors.

4. Contracting offices should address the risks of CMI in their acquisition strategy.

An acquisition strategy pursuing civil-military integration may have to budget more, rather than less, time due to compatibility problems resulting from integration. Contracting officers seeking to use commercial products in lieu of MILSPEC items should understand the environment in which the commercial product may have to operate. Before purchasing a commercial or non-developmental item for stand-alone use or for insertion into a military platform, contracting officers should obtain reliability and maintainability data.

If there is a chance that a producer might stop manufacturing a component, then a plan must be in place either to purchase the item through a designated second source or to obtain limited rights to the technology. Both plans add significant costs which may obviate any commercial savings.

Procurement officers should view the integration of commercial components or NDIs as a design responsibility. They should acquire only systems that use open systems architecture to eliminate or reduce the need for data rights. This will reduce the reliance

on single-source components or products. Even with commercial standards in place, different suppliers' products may not always be interchangeable or compatible.

The marketplace will drive the availability of selected components. With diminished control of the marketplace through CMI, the Government should recognize logistic support as a significant risk in the acquisition process. Therefore, contracting officers should ensure that commercial items integrated into military systems can be easily upgraded. If production of an older component is discontinued, it can be replaced with the latest component in the marketplace.

D. ANSWERS TO RESEARCH QUESTIONS

1. Primary Question: What is the viability of civil-military integration as a policy option for expanding the defense industrial base?

Civil-military integration is currently not a viable policy option for expanding the defense industrial base. The risks of discontinued components, lack of standardization, and security risks from technology transfers, as well as the extensive Government-imposed barriers, prevent effective integration. For the foreseeable future, there will be items so uniquely military that integration at the prime contract level will not be possible. The Government has established many of the existing regulations that serve as barriers for legitimate reasons. The task of removing them and changing the culture of those who operate under them is a significant task. Removing the barriers and changing the culture may take several years, if it occurs at all. Until then, other policy options for maintaining the defense industrial base should be considered.

2. Subsidiary Question 1: How does the weapons market differ from the free market?

The weapons market and free market are different primarily in the contracting methods each side currently uses and in the roles of the participants. Government contracts for research and developmental products are generally cost-plus in order to share risks with the contractor, while commercial markets rely almost exclusively on fixed-price contracts. The Government also uses contracts that promote social goals and programs that firms operating in the commercial environment do not have to consider.

The Government's role in the weapons market is that of a buyer, regulator, specifier, and judge of claims. In the commercial market, a contractor serves as a buyer and specifier. The primary difference is in the Government's regulatory role in the defense market.

3. Subsidiary Question 2: How does civil-military integration contribute to the desirable characteristics of the defense industrial base?

A unified industrial base provides surge capacity and potential manufacturing capabilities that the nation may rely upon in the future. The use of civil-military integration will enhance competition and result in a more efficient and innovative base and, perhaps, less dependency on sole-source providers. The potential size of the industrial base is increased through civil-military integration and therefore it may provide national security benefits.

4. Subsidiary Question 3: What are the benefits and costs of civil-military integration?

The benefits of civil-military integration are access to leading-edge technology, affordability, and the ability to meet surge capacity. The military will be able to

introduce the latest technologies into the development stages of a weapons program or upgrade. Many commercial technologies and components can meet the performance requirements of military systems at a lower cost. Close integration with commercial manufacturing capabilities will make it easier to gradually increase production of systems needed for a military effort.

The costs of civil-military integration are the increased complexity of integration and the management of logistic support and maintainability. Weapon systems designed to operate using a commercial component are at risk if the supplier discontinues production and holds the data rights. Additionally, components manufactured under a similar commercial standard may not always be substituted with each other in a weapons system. The design stage will have to mitigate this risk.

5. Subsidiary Question 4: What are the barriers to civil-military integration?

The barriers to civil-military integration are regulatory rather than technical. While the Government promotes the integration of the defense and commercial industrial bases through initiatives, it leaves in place the legislation and regulations that segregate the two. The primary barriers identified were: accounting requirements, MILSPECS, unique contract requirements, and technical data rights. Regardless of the way in which integration is to be accomplished--attracting commercial firms to defense work or encouraging defense firms to move into commercial work--the common barrier is Government regulation.

6. Subsidiary Question 5: At what stage of the acquisition cycle should DoD attempt to expand the defense industrial base through civil-military integration?

Civil-military integration is best achieved at the earliest stages of a weapons program. Market research can identify the superior technologies available in the commercial sector and design them into a platform. During the early phases of a weapons program, designers can establish the capabilities and limitations of commercial items and determine whether they are acceptable for insertion into the platform. If they are found acceptable, then the design must allow for the replacement and upgrade of the components. Early identification of compatibility and integration risks will prevent costly redesign prior to entering low-rate initial production. As the system moves closer to the production stage, opportunities to integrate commercial technologies diminish due to integration risks.

E. AREAS FOR FURTHER RESEARCH

This thesis identified areas that merit additional research, but did not address them because they are beyond the scope of this study. These areas are:

1. An in-depth study of the dual-use initiatives to determine their success in attracting commercial firms.

2. A dual-use initiative study that focuses on components that must be integrated into higher assemblies. The issues of reliability, maintain-ability, and logistic support could be presented.

3. A case study of the Commercial Operational Support Savings Initiative which follows the transition of contractors from Stage I to Stage II. The study would provide insight into concerns of participants in moving from "other transactions" to traditional contracts.

APPENDIX A. MAJOR MERGERS AND ACQUISITIONS 1990-1996 (VALUE IN MILLIONS OF DOLLARS) [REF. 67]

Date	Action	Value
July 1990	Loral Corp. Purchases Ford Aerospace	$715
August 1992	Hughes Aircraft buys General Dynamics (GD) Missiles Loral Corp. buys LTV Missiles	$450 $254
October 1992	Carlyle Group buys GD Electronics	$50
February 1993	Lockheed Corp. Buys GD Ft. Worth Division	$1,500
April 1993	Martin Marietta Corp. Buys GE Aerospace	$3,050
July 1993	Carlyle Group buys Philips/Magnavox Electric Systems	$250
December 1993	Martin Marietta Corp. Buys GD Space Systems	$209
January 1994	Loral Corp. buys IBM/Federal Systems Co.	$1,485
February 1994	Westinghouse buys United Tech Corp, Norden Systems	$45
March 1994	Northrop buys Grumman Corp.	$2,170
May 1994	Allied Signal buys Textron Lycoming Turbine Orbital Sciences buys Matra Hachette/Fairchild	$375 $93
September 1994	Lockheed and Martin Marietta announce merger	$10,000
March 1995	Loral Corp. buys Unisys Defence	$800
April 1995	Raytheon buys E-Systems	$2,300
August 1995	GD buys Bath Iron works	$300
September 1995	Hughes Aircraft buys Magnavox from Carlyle Group	$370
December 1995	Grumman agrees to buy Westinghouse	$3,000
January 1996	Lockheed Martin buys Loral	$10,000

Source: Jane's Defence Weekly, Vol. 25, No. 3, p. 24, January 17, 1996.

APPENDIX B. MILESTONE DECISION POINTS [REF. 68]

A milestone is the decision point that separates the phases of a Major Defense Acquisition Program (MDAP). For a definition of MDAP see 10 USC Sect. 2430.

Milestone 0: Approval to Conduct Concept Studies

After the Joint Requirements Oversight Council validates the mission need for an Acquisition Category (ACAT) I program, the USD (A&T) shall convene a Milestone 0 Defense Acquisition Board (DAB) to review the mission needs statement (MNS), identify possible material alternatives, and authorize concept studies if they are deemed necessary.

Milestone I: Approval to Begin a New Acquisition Program

The purpose of the Milestone I decision point is to determine if the results of Phase 0 warrant establishing a new acquisition program and to approve entry into Phase I, Program Definition and Risk Reduction.

At Milestone I, the MDA shall approve the following:

1. Acquisition Strategy;
2. Cost as an Independent Variable (CAIV) objectives;
3. Acquisition Program Baseline (APB)(10 USC Sect. 2435 for ACAT I) ; and
4. Phase I exit criteria.

Milestone II: Approval to Enter Engineering and Manufacturing

The purpose of the Milestone II decision point is to determine if the results of Phase I warrant continuation of the program and to approve entry into Engineering and Manufacturing Development (or software engineering and development for a software

intensive system). The low-rate initial production (LRIP) strategy and decision authority shall be considered at this milestone.

At this Milestone, the MDA shall approve the following:

1. Acquisition Strategy;
2. CAIV objectives;
3. APB (10 USC Sect. 2435 for ACAT I);
4. Phase II exit criteria
5. LRIP quantities (10 USC Sect. 2400)

A favorable LRIP decision authorizes the Program Manager to commence LRIP only. The PM is only authorized to commence full-rate production with further approval of the MDA. There shall be normally no more than one decision (i.e. either low-rate or full-rate) at the DAB level.

Milestone III: Production or Fielding/Deployment Approval

The purpose of the Milestone III decision point is to authorize entrance into production for an ACAT I or into deployment for an ACAT IA program.

At this milestone, the MDA shall approve the following:

1. Acquisition strategy;
2. APB (10 USC Sect. 2435 for ACAT I); and
3. Phase III exit criteria if appropriate

Note: The decision to proceed beyond LRIP cannot be finalized until the DOT&E Beyond LRIP and LFT&E reports are received by the Congressional Defense Committees (10 USC Sect. 2399 & 10 USC Sect. 2366). *Not applicable to ACAT IA programs.

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